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ABSTRACT

The unified science approach to instruction is one in which the concepts and processes of science are presented to emphasize the fundamental unity of scientific thought rather than the distinctions among the various scientific disciplines. The general thrust of this program is to provide students with motivating, meaningful units that will emphasize science as a quest for the solution of real societal problems through research and investigation. Chapters include "Developing a Unified Science Approach"; "Planning and Preparation"; "Evaluation of Student Performance" and six issues to examine including: (1) "Environmental Decisions"; (2) "Science and Crime"; (3) "Disasters"; (4) "Consumerism"; (5) "Food and Nutrition"; and (6) "Science, Technology and Auto Safety." Each issue contains backround; course outline, including key questions and performance objectives; and activities. Appendices include "Additional Issues"; "Activity References"; "General References"; "Sample Evaluation Items"; "Reading and Writing in Science"; "Goals of the Board of Regents for Elementary and Secondary Education in New York State"; "Excerpts from a National Science Teachers Association Position Statement"; "Guidelines for the Use of Vertebrate Animals (Humane Treatment)"; and "Students with Handicapping Conditions." (CW)

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UNIFIED SCIENCE

SOLVING PROBLEMS IN SCIENCE, TECHNOLOGY, AND SOCIETY

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UNIFIED SCIENCE: SOLVING PROBLEMS IN SCIENCE, TECHNOLOGY, AND SOCIETY

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of Curriculum Development
Albany, New York 12234

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Foreword

The syllabus, *Unified Science: Solving Problems in Technology and Society*, is intended to provide a meaningful program leading to general scientific literacy for the students of New York State.

In the Commissioner's Regulation, Section 100.5, Part (a) (8), paragraph (i) specifies a new "second year in science" requirement for graduation. It reads as follows:

> "The second unit of credit in science shall *deepen the understanding or broaden a student's application of life, physical and/or earth sciences* beyond the level in the State science syllabi for grade 7, 8, and 9 and in accordance with criteria established by the Commissioner.

This syllabus provides school districts with a means of "broadening a student's application" of science as well as maintaining the emphasis on inquiry and problem-solving skills which was begun in the elementary science program. A unified science approach has been selected because of its inherent flexibility and its interdisciplinary nature.

The principal instructional emphasis of this syllabus is to teach science as investigation and research which leads to the understanding of real scientific/technological/societal problems that have relevance in students' lives. The syllabus emphasizes the teaching of positive attitudes about science and decisionmaking. It includes instructional outlines and a variety of helpful appendices.

The syllabus is based in part upon a draft which was prepared by **Joseph Accongio, Elena Brandes, Peter Hammar, Jean Slattery,** and **Robert Stevenson** of the City School District of Rochester. Contributions to the various drafts of this publication, herein gratefully acknowledged, were made by **Mr. Accongio, Ms. Brandes, Dorothy Rosenthal,** Rush-Henrietta Central School District, **Charles Hill,** Carmel Central Schools, and **Jon Harkness,** Wausau Public Schools, Wausau, Wisconsin. The draft was field tested at numerous locations in the State and the Department acknowledges the following teachers who contributed to the publication's progress in this manner.

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Barry Jamason, Associate, Bureau of Curriculum Development, developed the format of the publication and revised various portions of the draft.

Thomas Boehm, Associate, Bureau of Science Education, and **Mr. Jamason** coordinated the development of the syllabus.

This publication was reviewed to include information on, and awareness of, persons with disabilities by the staff of the Office for Education of Students with Handicapping Conditions.

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Letter to Teachers

The general thrust of this program is to provide students with motivating, meaningful units that will emphasize science as a quest for the solution of real societal problems through research and investigation. The program also emphasizes the teaching of "positive attitudes about science."

Unified Science will be available to those students who select this flexible course of study as an option toward earning the second unit of credit in science as now required for graduation by Part 100 of the Commissioner's Regulations. Many young people who opt for Unified Science will be those who prefer not to tackle the more traditional science courses and who may also feel that they lack the mathematical skills needed to effectively deal with problem-solving situations in chemistry, physics, and even earth science.

Unified Science has appealing characteristics. It focuses on critical thinking, problem-solving, and decisionmaking by examining real issues that affect society. Student investigators come to understand the interrelationship of science, technology, and society by studying situations that are, or should be, in the forefront of the public consciousness. Therefore, it is appropriate for classes to investigate topics such as nutrition and food supply, pollution, science and criminal investigation, safety and product design, and such other topics as may be selected by the teacher or (ideally) offered for consideration by the students themselves.

The beauty of Unified Science is its flexibility and its potential responsiveness to the genuine interests and concerns of the students. Unified Science thus provides the teacher and the class with a wonderful opportunity to focus on the pressing environmental concerns of today, as well as the role of science, technology, and society in addressing these concerns and presenting fair, workable, and affordable solutions to those problems. Unified Science will also provide a setting in which teachers and students can explore their individual and collective role in both the creation and the resolution of diverse environmental issues. Through an analysis of their own behavior and environmental attitudes, this program will do much to promote positive attitudes and actions on the part of the individuals involved in the course.

Clearly, Unified Science is not a textbook-oriented course. The final selection of units will rest with the local district, and with each teacher. Therefore, teacher training takes on immense importance, if students in one part of the State are to receive an educational experience which is as valuable, well- balanced, and well-planned as the curriculum offered to students in other parts of the State. Teachers will have to be shown how to respond to the interests of the students and craft a meaningful unit plan which is neither too difficult nor too easy for the class, yet which addresses the general underlying principles of Unified Science.

Who will teach this course is another important concern. It is not unlikely that the more experienced science teachers will be programmed into the Regents and accelerated science courses. The strong possibility exists that less experienced teachers will be assigned to Unified Science, as this will be the final required science course for those potential graduates who will not seek to take further coursework in the sciences. Will those teaching this program have the creativity to develop units in response to student need and interest? Will they be able to locate appropriate resources – audio-visual materials, readings, case studies, simulations, software, laboratory investigations, field trip guides – needed to present a cohesive unit to the class? Will they be able to plan in such a way as to avoid developing and offering a course which might be lopsided toward any particular traditional science or which might overemphasize the interests, experiences and values of the instructor? Will the instructor recognize the interrelationship of the sciences, communication skills, social studies, and other areas of the curriculum as they impact on the issues under investigation in their Unified Science programs? These are key concerns.

Staff development offered statewide and locally during the summer and the school year will be required. The statewide focus might be on the common philosophical and pedagogical threads that should be woven through Unified Science wherever it is taught in New York State. The experiences of teachers in various cities who have already planned, implemented, and evaluated their customized forms of Unified Science should be shared with neophyte instructors. The syllabus should serve as a

planning guide for those who will be required to identify and develop units of their own choice. A newsletter or computer bulletin board should be established to provide the foundation for an ongoing communication network among teachers and supervisors involved in this course of study. Good ideas and pitfalls should be identified and shared quickly and efficiently. Perhaps teleconferences could be offered throughout the State to provide educators with an opportunity to share their progress and problems related to this effort. Every reasonable and affordable effort to utilize available high technology in preparing teachers to teach a course dealing with various aspects of technology in our society would be most appropriate.

Training on the local level should take advantage of the expertise of science education associations, environmental education centers, science and technology museums, zoos and aquaria, and municipal agencies that deal with the issues most likely to be addressed by classes in Unified Science. Teachers must gain a familiarity with the helpful organizations and resources located and working within and near their community. Summer institutes which capitalize on the programs and personnel of such resource agencies should be a key component of any staff development in this area.

Another important consideration in the design of a staff development program is the need to train teachers to recognize and deal effectively with controversy in the classroom. It is essential that the teacher act as a facilitator, a catalyst and as a resource person in the classroom, not as the source of all wisdom and answers. Students, while investigating a topic, may embrace opinions and positions on certain environmental or social questions which are different or even opposed to that of the teacher. The teacher must feel confident that he/she can respect the opinions of students, particularly if these opinions represent the outcome of careful analytical research on the part of the students. Dealing with differences of opinion is one of the exciting and sometimes frustrating opportunities and responsibilities that we are provided with in a democracy.

– Adapted from a letter written by ***John Kominiski,***
New York City Schools

Introduction

The unified science approach to instruction is one in which the concepts and processes of science are presented so as to emphasize the fundamental unity of scientific thought rather than the distinctions among the various scientific disciplines. A basic assumption of unified science is that the whole of science is potentially more meaningful and valuable for individuals who are probably concluding their formal study of science, than another year of specialized science. Unified science is designed to improve students' scientific literacy, that is, the ability to think critically, make decisions, solve problems, and become capable, contributing members of society.

Teachers are encouraged to select issues that are inherently interesting to students and will allow them to experience science as a process, as well as a body of knowledge with relevance to the everyday world. Such a perspective encourages flexibility in the selection of issues and in the organization and structure of a syllabus. The units and activities that are suggested in this syllabus are meant to provide teachers with models for developing other interesting and useful opportunities for students to:

- acquire science knowledge and skills.
- develop positive attitudes about the value of science to everyone in today's society.
- perceive the role of science in the solution of today's problems and issues.
- understand the interrelationship of science, technology, and society.
- improve their ability to make decisions.
- enhance the quality of their lives through the use of these newly acquired understandings and skills.

Major Purposes

The major purposes of this second year of science offering are as follows:

- To be an option for completing the second unit of science required for a local diploma.
- To provide a unit of science that can be used as part of a 3-unit sequence in science for a local diploma.
- To present an opportunity for all students to sample activities which represent applications of a wide variety of science concepts.
- To impart to students understandings about the relationship of science to everyday situations, problems, and issues.
- To help teachers develop activity settings in which students will improve their ability to solve problems and make decisions.

Rationale

There are many students in our schools who have, at best, an indifferent attitude about science. Science courses with a great deal of emphasis on the acquisition of knowledge leave these youngsters wondering, "To what end?" It is herein presumed, however, that these same students would respond positively to a course of study which views science as a means to an end rather than an apparent end in itself. In this instance, the end would emphasize scientific knowledge, skills, positive science attitudes, and decision-making skills as tools for dealing with everyday problems of the kind that our increasingly technological society creates. Specifically, students should perceive and use science as the means to solve everyday problems in the home, school, and job site which are of a physical, mechanical, or technological nature; e.g., to avoid unhealthy foods; to understand and/or survive natural and human-made disasters; and, to learn to make decisions about those actions that affect the environment.

Nature of the Syllabus

This syllabus should serve as a model and as a beginning for a course dealing with science, technology, and society to be developed locally. The issues which are presented in this syllabus are merely arbitrary selections from the many topics appropriate for a unified science approach. No syllabus can provide a complete guide to all topics, nor would all topics be appropriate for all school settings.

Each issue includes background information, a content outline, key questions, performance objectives, a few activities, and references. As presented, these issues and their elements are merely illustrations of the manner in which the local course might be developed. The first issue, *Environmental Decisions*, examines human impact on the world around us, with particular attention to the fact that we ultimately experience the counterreaction.

The next issue, *Science and Crime*, is a brief adaptation of the unit, "Crime Prevention," which was developed as part of the Rochester City School District's *Unified Science Education* syllabus project. It has high interest value for students as a context in which to acquire knowledge and to develop scientific attitudes and skills about a particular societal issue.

Disasters deals with natural disasters and their impact on people. *Consumerism* teaches students the basics of wise decisions in the market place. *Food and Nutrition* deals with the relationship between humans and food on a personal, community, and global level.

A sixth issue, *Science, Technology, and Auto Safety*, is presented with only a brief outline. This unit requires even more substantial curriculum work at the local level than the others in order to constitute a completed unit plan.

It must be emphasized again that these six issues would not constitute *the* course in science and technology. The issues, their outlines, questions, performance objectives, and activities have been presented for purposes of illustration and as a foundation for a fully-developed local course of study. Districts may select six issues from the examples given or prepare from the list of additional titles provided in Appendix A, or their own issues as the basis for a locally-developed course. Each unit might be from four to six weeks in duration.

Insofar as possible, activities which support the issues should begin with family or personal experiences, then expand outward to activities which deal with the community, the nation, and the world. In this way, students move gradually from familiar all the way to global settings and understandings.

Problem-Solving

1. Definition of the Problem

Before a student can solve a problem, the student must recognize that there is a problem to be solved. To help your students recognize a problem, use their **EXPERIENCES** to make them aware of **DISCREPANCIES**. The discrepancies should lead them to raise **QUESTIONS**, and the questions will help them to define the problem.

EXPERIENCES can be both spontaneous events and teacher-planned activities. The experiences you choose for instruction should be ones that make a student aware of discrepancies.

DISCREPANCIES are differences, inconsistencies, disagreements, or disharmonies that we encounter. A discrepancy becomes evident only when we have some prior experience or basis for comparison.

Discrepancies may be grouped into six general categories. An example for each is included.

A goal to achieve without a means to achieve it.

- A person needs to fix a pair of eyeglasses, but has no replacement screw.

A difference between what the student expects to observe and what the student actually does observe.

- Ice sinks in a liquid.

A lack of knowledge – others may know the information, but the student does not.

- Acid rain results in the deterioration of some buildings and statues.

A difference between what the student has been told is true and what the student has already verified personally.

- A student is told that light-colored objects become hotter in sunlight than dark-colored objects, but knows that the reverse is true.

A conflict (internal or external) between interpretations, opinions, attitudes, or values.

- A person wants to experience wilderness, but takes a battery-powered radio on a camping trip.

A difference between an existing set of conditions (what is) and a desired set of conditions (what should be).

- People are starving in some areas of the world.

QUESTIONS play a vital role in problem-solving because they help to identify and define the problem and to guide the systematic search for a solution. Once a student recognizes a discrepancy, you should encourage the student to construct many questions about it. It is important that you teach students to construct precise questions. When a student has constructed a precise question, the student has more clearly identified the problem.

Questions can be used to focus inquiry. The categories of questions and the focus of each include:

Category	Focus
who?	a person or group
what?	an object or event
when?	time
where?	a location
which?	a choice (alternative)
why?	a reason or explanation
how?	a procedure or process
what if?	speculation

2. Model for Problem-Solving

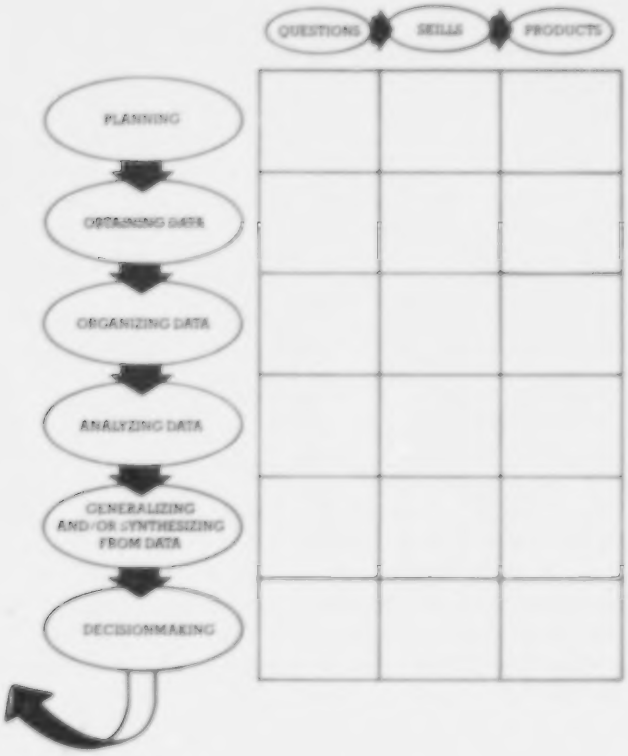
Once a student has identified a problem by constructing a precise question, the student can proceed with problem-solving.

The model for problem-solving is a sequence of steps. The steps begin with planning and progress to decision-making. This is shown along the left side of the illustration below. In the sequence a problem-solver must engage in the following tasks:

- constructing questions;
- identifying, selecting, and applying skills; and

– creating tangible products which contain answers to the questions.

This is shown across the top of the illustration below.



Since the model is organized into a sequence of steps with specific tasks for each step, one can isolate each step for instruction. Once a student learns the tasks for each step, the student will be able to use them, either deliberately or automatically, to solve new problems.

QUESTIONS

The problem-solver should construct many precise questions that will help clarify the problem and the steps that must be taken to solve it. This may be done in a brainstorming-style activity. The student should view each precise question as a little piece of the problem to be solved. There is no need initially for the student to organize the questions. That task is part of the planning step.

SKILLS

The problem-solver can obtain an answer to each precise question by applying appropriate skills. Students should be taught to select and apply the best skills for the specific task implied by the question.

PRODUCTS

The problem-solver creates a tangible product by applying the appropriate skills to the specific task. For example, by applying the skill of recording data, the problem-solver may create the tangible product of a chart or graph. The tangible product contains an answer to the question.

Planning – A problem-solver uses a sequence of focus questions to construct and organize the precise questions.

Students should be taught that when they construct a plan, they must always assume that the plan may have to be revised in light of new information.

Obtaining Data – The problem-solver gathers data that may have an impact on the solution to the problem. Quantitative as well as qualitative data may be needed.

Organizing Data – The problem-solver establishes some pattern of order or form with the data obtained.

Analyzing Data – This step requires that the problem-solver seek apparent patterns and relationships in the data, to recognize characteristics that suggest cause and effect, and to state inferences.

Generalizing and/or Synthesizing from Data – Here, the problem- solver creates conclusions or alternative choices (potential solutions to the problem) to use in the next step, decisionmaking.

Decisionmaking – In the decisionmaking step, a problem- solver uses a sequence of focus questions to arrive at a decision.

Although the problem-solving model is organized into a sequence of steps that have a logical progression, it is important to note that, in practice, problem-solvers often move back-and-forth among the steps as a problem is worked on. For example, a need to reorganize the data may not become apparent until the data are analyzed. Or a problem-solver may realize as the data are being analyzed that additional data must be obtained.

Developing a Unified Science Approach

The goals of unified science are to teach all students general principles of science, the relationship of science to their lives, and the application of scientific skills to real world problems. The organization of unified science is based on the premise that these goals can be achieved by starting with any number of science-related issues. The particular issues selected should be those of greatest interest to students and of most significance to the local, national, or global community.

Developing a local course of study using a unified science approach differs from curriculum development in traditional science courses, in which content is prescribed by the State syllabus. In unified science, the specific content depends on the topics selected and it is expected that all such courses will teach certain principles, skills, attitudes and applications.

The purpose of this section of the syllabus is to define the principles, skills, attitudes and applications that characterize a unified science approach and to provide guidelines for development of the actual course of study at the local level.

General Principles

The following is a series of characterizations of both the approach of the course, unified science, and the context, science and technology.

- The basis of scientific knowledge is observation of the natural world.
- Controlled observation (experimentation) is used whenever possible in science.
- Proof in science is conditional and based on degrees of confidence; i.e., it is probabilistic.
- Technology is the application of knowledge of the natural world to provide things or processes that are needed or desired by people.
- Historically, technology developed before science and was relatively independent of science. Today however, much of new technology depends on scientific knowledge and new technology often leads to scientific advances.
- Knowledge gained from scientific and technological research is always subject to change as a result of additional research and development.
- Scientific knowledge and skills can be used by individuals to analyze situations, synthesize knowledge, and solve problems in their own lives.
- Problems in the real world cross the boundaries of the traditional disciplines. Therefore, in unified science, the study of issues that involve more than one scientific discipline is more relevant to many students than traditional science courses.
- The process skills of science have application to the social and behavioral sciences, as well as to the natural sciences.
- Science and technology affect society and society affects the direction of scientific research and technological development.
- Scientific and technological advances often have ethical implications and give rise to controversy. These implications are not only for human, but also for nonhuman communities.
- Scientific and technological advances often have spinoff effects that benefit persons with disabilities.
- Science and technology can contribute to the solution of social problems. Analysis of these problems requires cross-disciplinary perspectives and a holistic approach.
- Decisionmaking and problem-solving involve morals, values, and aesthetics as well as knowledge.
- Individuals can utilize knowledge of science and the processes of science to help them make responsible decisions.
- Citizens are responsible for recognizing science-technology-society problems, becoming informed about them, and participating in their solution.
- Individuals can solve problems more effectively by sharing information and talents, teaching each other, and by working together.
- Learning about the interactions among science, technology, and society is a continuous, lifelong process.
- Using a unified approach to learning science will enhance students' understanding of themselves and their relationships to their natural, cultural, and social environments.

Unified Science Skills

Students will be able to:

- identify persistent science-technology-society issues.
- gather information pertinent to identified issues from a variety of sources.
- view problems using information from a variety of disciplines.
- analyze the components of science-technology-society issues.
- formulate hypotheses and alternative solutions to problems.
- select and carry out appropriate methods for investigating problems.
- make decisions based on the results of problem-solving and act upon these decisions.
- organize and publicize information about science-technology-society issues.
- apply knowledge and methods to new situations.

Comparison of Traditional Science Courses and Unified Science Courses

The chart below compares some typical characteristics of traditional science courses and courses which use a unified science approach. The characteristics listed for unified science are similar to those identified as the desired state for all science courses by *Project Synthesis* (Harms & Yager, 1981).

Traditional Science Courses	*Unified Science Courses*
discipline-based	interdisciplinary
content-oriented	context-oriented
emphasize topics in science	emphasize science-technology-society issues
cognitive domain is primary	emphasize integration of the domains
stress the scientific method; theoretical	stress the nature of science; applied
emphasize drawing correct conclusions	emphasize decisionmaking
laboratory work is investigative	laboratory work is experiential, as well as investigative
classroom-bound	extend into the community and the environment
textbook-centered	utilize multiple resources
emphasize replication of knowledge	emphasize application of knowledge

Scheduling

The minimum time recommended for this course is six, 40-minute periods a week for a full school year. These periods should include at least one double period per week to allow time for extended activities, such as laboratory activities, speakers, and field work.

The Teacher in Unified Science

The teacher using a unified science approach is primarily a catalyst, provoking students to acquire, analyze, and apply information, rather than a disseminator of information. The teacher organizes appropriate learning experiences, asks probing questions, and encourages the use of multiple sources of information. The teacher models the unified science approach for students by bringing a variety of perspectives to the issues studied. The teacher must also encourage knowledge-based conflicting points of view and be willing to learn along with the students.

Effective unified science teaching requires a variety of instructional methods that promote active learning. Laboratory activities should be experiential as well as experimental. Field work, library work, and community projects should be included in conjunction with laboratory investigations. In addition, teachers should encourage discussions, cooperative group activities, roleplaying, and extensive use of community resources.

The Laboratory

An effective laboratory experience is an essential component of unified science. Experiences should extend beyond laboratory activities that have definite answers to include some open-ended investigations. Some of these open-ended activities should be introduced and developed by students. Experiences should also extend beyond the laboratory into the field and into the community. The laboratory period should provide opportunities for students to obtain knowledge from many sources and to learn to view information sources critically. Experiences should be designed to capitalize on local resources and interests. Finally, the laboratory should provide time for students to interact with each other and to simulate decisionmaking processes that are used to resolve issues in society.

Facilities

Unified Science should be taught in a laboratory setting with equipment appropriate for those topics selected for the course. A general science or biology classroom/laboratory provides the flexibility needed for an interdisciplinary course. The laboratory setting should be accessible to all students with handicapping conditions. Adaptive devices, special tables, and low sinks may be needed for some students with handicapping conditions.

It is intended that the course developed use existing resources from all areas of science in new and creative ways. Instruction should not, however, be limited to the laboratory setting. What is desired is a greater use of the environment and the community as sources of information and subjects of study.

Resources

The course to be developed for this second year of science should not be textbook-oriented. Teachers and students should make use of multiple sources of information, including newspapers, books, magazines, experts in the community, museums, and the media, as well as local environmental sites and phenomena. A list of basic resources is provided in Appendix B. Additional sources of ideas for resources appropriate for students with handicapping conditions are available through the Special Education Resource and Training Centers (SETRC) located throughout New York State. Other teachers' unified science programs are also excellent sources of ideas for resource materials.

Planning and Preparation

This syllabus is only a starting point for developing a *Unified Science* course. To complete development at the local level, districts which adopt this syllabus will need to provide time for program planning prior to and during the initial year. This will allow teachers to select the topics, develop objectives, and write activities for the local course. Special education teachers who will be providing equivalent or supplemental instruction in this syllabus to students with handicapping conditions would be an important addition to the local writing teams. Summer curriculum workshops are recommended for this purpose. In addition to the material on the six issues outlined in this syllabus and the list of resources in the appendix, the Bureau of Science Education will provide information to schools about establishing a communications network for developing unified science programs.

A typical way for a teacher to proceed with preparations for teaching *Unified Science* is the following:

- Obtain approval from the school administration and the board of education to use *Unified Science* as a course offering.
- Determine which six issues will provide units of instruction for the school year.
- Beginning with the brief outlines provided for the six issues in this syllabus or substituting other issues and other outlines, expand the detail of the topic with material appropriate to the students' needs and interests. Try to introduce the issue in the context of a local problem, moving later to problems with national and global significance; i.e., from the familiar to the less familiar.
- Develop some understandings, key questions, and performance objectives for the students, noting skills, attitudes, and understandings you would anticipate being able to observe or assess at the issue's conclusion.
- Using the list of references and activity sources, select or develop activities that address the understandings in the same manner as illustrated in the activity samples provided.
- Use a problem-solving mode in developing a series of student questions for each activity which addresses discrepancies. (See **Problem-Solving,** pp. 4-7.)

Begin instruction with a willingness to change, adapt, and respond to the interests and needs of the students and to current events. The course should not be a static one; curriculum development needs to be an ongoing process. Active involvement of students in choosing issues and activities will motivate students and contribute to their intellectual growth. Teachers who have tried these approaches have found them rewarding and discovered that students are capable of far more initiative and imagination than was previously thought.

Teachers will need to move away from the traditional discipline-oriented, content-based, teacher-centered approach to which students are probably accustomed. An important key to the success of this approach is the appropriate choice of issues and levels of expectation for students. Teachers may begin by using the familiar teacher-directed mode of instruction and moving toward increasing degrees of student-selected and -directed activities. The following scheme suggests some steps to take in shifting to more independent learning on the part of students.

1. *Teacher provides topic, problem, procedure, and results.*
   All elements of the inquiry process are provided to students by the teacher. This approach is suitable to the early weeks of the course, to studies of classic experiments in the history of science, or to topics too difficult for students to investigate on their own.
2. *Teacher provides topic, problem, and procedure.*
   Students carry out an investigation following the procedure given to them. This approach, sometimes known as the "cookbook" approach, has merit in that students can experience a great deal of science in a relatively short time. It provides opportunities for students to validate abstract principles for themselves in a concrete way.
3. *Teacher provides topic and problem.*
   Students develop their own procedures and carry out investigations. This approach, while more time-consuming than the first two, allows students to experience science as a process of controlled observation. Because students do not know what the results should be, they can experience the excitement of research. Teachers who use this approach

find that it can be a motivator for otherwise disinterested students.

4. *Teacher provides topic.*
   The student who begins a piece of research restricted only by the choice of topic is free to select an appropriate problem and procedure. This approach increases students' inquiry skills, independence of the teacher, and intrinsic motivation.
5. *Teacher provides an opportunity for investigation.*
   Teachers will want to provide several opportunities throughout the year for students to investigate topics of their own choosing. This approach enables students to pursue topics of personal interest and to use the skills and knowledge gained from more structured learning experiences. Employing a variety of levels will enable teachers to provide investigations that are appropriate to a wide range of students' abilities and skills. (See Appendix E.)

Teachers who plan only one level of investigation for the school year will find that students will become bored and inattentive. As a result, many of the benefits of unified science education will be lost. Investigations should be of many types, from completely prescribed to totally open-ended.

*How One Teacher Began: A Journal**

Mid October: Our unified science class had spent the past five weeks sharpening skills – i.e., collecting and jotting data, making inferences, drawing conclusions, and, in general, using the time constructively while our new science room was being renovated. I was also waiting for the opportune time to initiate the unit, "The Science of Crime."

Early November: A local newspaper headline reads: "Housewife found murdered in nearby community. Police units from two states investigating the crime." Several days later another article stated: "Circumstantial evidence indicates a local handyman involved." A conversation with the Youth Officer of Putnam County revealed that the suspect had left several clues at the scene of the crime. – Enter, "Forensic Science Unit" – !

What had the students read about the case? (Newspaper clippings were available.) What forms of evidence were found by the police? Specifically, were any fingerprints left at the scene of the crime? How does one identify and lift fingerprints? Were hair and fiber particles analyzed? Did the suspect have any foreign soil on his shoes? Did the victim suffer any bites or unusual wounds to the body? Did the abandoned car, presumably left by the suspect, contain any useful pieces of evidence? Was the suspect seen in the vicinity of the corpse?

With the assistance of the Putnam County Sheriff's Department, students were introduced to "modern" forensic procedures. Officers personally reviewed the case and demonstrated the use of the department's "Identikit." The description of the procedures used to "identify" the fingerprints of the victim through the use of a laser was excellent and the "state of the art of the science."

Where did this specific crime take the class? Six weeks of intensive study of forensic science! Specifically, the following questions were investigated by the group:

1. How does one use an "identikit?"
2. What features of most attackers are best remembered by victims?
3. How are fingerprints analyzed and recorded?
4. How does one identify and analyze specific foreign objects found at the scene of the crime (e.g., soil, natural organic matter, fibers, etc.).
5. What penalties apply to specific crimes?
6. What techniques are used to analyze notes left at the crime scene?
7. How are teeth marks used for identification?

This sample of specific student questions generated a multitude of sub-units dealing with the above topics. A commercially available "Foreign Object Analysis Kit" and a "Document Analysis Kit" provide excellent activities in these areas. A copy of the "Penal Law of New York State" was invaluable in researching penalties for specific crimes. (Your students or their friends may be personally involved with law enforcement agencies. Leave ample time for discussion.)

Conclusion

One outcome of this unit was an invitation to visit the Putnam Correctional facility. Police procedures were explained and volunteer students were "booked."

In August, the suspect in the case was tried, found guilty, and was sentenced to 25 years to life for the murder of the young housewife. (Had school been in session the class would have attended.)

Gratitude is expressed to the Putnam County Youth Officer for his many unselfish hours in educating this teacher and his students.

*Excerpted from the personal notes of Charles Hill, Science Department Chairman, Carmel Public Schools, who was a field test participant.

Evaluation of Student Performance

Many students who will be taking this second year of science course have had a less than exemplary record of testing. For some, lack of motivation, poor study habits, and disinterest are the reasons for this. Others are simply intimidated by evaluation procedures because of early failures or because their abilities were no match for the tests they were given.

A locally designed course based upon this guide can stimulate greater interest in schoolwork through the variety and usefulness of the content. Motivation and concomitant feelings of self-worth can arise from some success. The success might, in part, be related to a slightly different approach to evaluation for this course.

It is suggested that the emphasis be on *formative* evaluation as opposed to *summative* evaluation. Summative evaluation is the type of evaluation used at the end of a term or course for the purpose of grading students or evaluating their progress. Formative evaluation is the type of evaluation used during the instructional process for the purpose of improving both teaching and learning. In formative evaluation, an effort is needed to reduce the judgmental aspects of evaluation.

Formative evaluation may be used to assess frequently the students' levels of mastery of the many useful process skills that will be included in the course. Mastery of these processes can be determined through observation of the students' ability to apply principles and generalizations to new problems and situations. In this way, the teacher can be reasonably assured that students have acquired the skills that are being taught.

Both formative and summative evaluation of student performance in unified science involve a variety of measures. Traditional paper and pencil tests are only one of many ways in which student performance can be assessed. Written and oral reports, participation in discussions, simulations, and special projects by individuals and groups are also valid measures of student learning. Self-assessment by students will encourage them to become independent learners and develop their own standards. When paper and pencil tests are used, these should emphasize application, analysis, synthesis, and transfer of knowledge rather than recall and should address attitudes and skills, including problem-solving, as well as knowledge.

Some examples of test items which can serve as models for developing a summative evaluation instrument are provided in Appendix D.

Some students with handicapping conditions need alternative testing techniques to demonstrate mastery of skills and attainment of knowledge. (See Appendix I.)

In teaching and evaluating science skills, it should be recognized that there are numerous methods for solving problems in science; i.e., there is no single "scientific method." In practice, science is highly flexible and personal. The methods of science are more than measurement, laboratory technique, and data processing followed by logical deductions. Incentive, ingenuity, intuition, imagination, creativity, and an aesthetic sense are important ingredients in the process. The search for truth about the natural world is the essence of the scientific enterprise but there are many ways this has been achieved.

ISSUE 1

ENVIRONMENTAL DECISIONS

Issue One

ENVIRONMENTAL DECISIONS

A. BACKGROUND

It took billions of years for the Earth to evolve to the point where the balance of minerals, water, and atmospheric gases could support life. Evidence indicates it took millions more years for life to evolve, with humans thought to be among the latest arrivals. We are significant because of our ability to "interfere" with the world around us. For a long time, human impact was limited by physical weaknesses both in numbers (population) and in skills. However, during the last few centuries, human population size has increased dramatically and people have developed technologies that can interfere on a large scale with the cycles, interactions, and ecological balances that evolved naturally over the eons.

Interactions and balances in the environment are constantly being altered and then renewed. Until recently, the relative magnitude and frequency of these alterations were such that animal and plant life could adapt to them. Problems occur when changes made by humans are so great and so rapid that natural processes cannot cope with them. To use an extreme example, scientific studies* indicate that a thermonuclear war lasting even a few minutes would constitute a crisis of survival for most, if not all, plant and animal species.

What will be the consequences in 100 years of our actions today? Are we exhausting fuel supplies that will be needed by future generations? Will air and water supplies be clean and safe for our great-great grandchildren? Will nuclear wastes contaminate the soil so that future generations will be unable to grow the food needed for survival? Are humans now taking a course of action leading toward a bright future for generations to come?

Some industrialists say that the problem is being exaggerated. They claim that pollution of the environment will be corrected by technology. Similarly, some economists contend that natural resources found in the environment are, in effect, inexhaustible in light of technological advances and human investments. To these people, environmentalists are alarmists who would have us restrict or stop growth as a solution to environmental problems.

Logically, these opposing positions cannot both be right. Most likely there are elements of truth to be found on each side of the argument.

Nonetheless, the way we presently live our lives has raised serious questions concerning our ability to guarantee useful, productive, and equally, if not more, rewarding lives for those who will follow us. For, *in striving to continually improve our quality of life, we frequently equate this better life with the development and acquisition of material goods and creature comforts,* which seldom guarantees a critical analysis of our needs and the consequences of our actions.

This way we live has also raised questions about our ability to guarantee the beauty, integrity, and stability of the natural environment to those who will follow us. We often overlook the fact that our natural environment is a closed system which must be protected in order that it may replenish itself and, in so doing, us. Finally, it raises questions about our ability to achieve some type of balance between the quality of life and the quality of the natural environment, for ourselves and for those who follow us. For example, there are elements within this closed system which, for all practical purposes, are not replenishable or renewable. We could consume these resources, and thereby trade off the quality of the environment in the future in favor of the quality of some human lives today. However, if we consume and abuse beyond this capacity for replacement, and exhaust that which is not renewable, we jeopardize our own survival. Even with our own survival secure, we may limit many options otherwise available to those who follow us.

The question then is, "What do we need to know about the environment and the problems that beset it, in order that we might make the right kinds of decisions about it and *our* lives?"

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* Ehrlich, P., Sagan, C., Kennedy, D., and Roberts, W. *The Cold and The Dark, The World After Nuclear War.* New York: W. W. Norton & Co., 1984.

B. ISSUE OUTLINE

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
I. Pollution	How does the fact of pollution affect the quality or quantity of resources available to humans?	• demonstrate by example the relationship between resources and pollution.
A. Air/Water – Any one of an environment's components, such as air, water, space, food, or energy may become a limiting factor.	How efficient is personal and family water consumption? (**Activity 1.1**) What are the common air pollutants and their sources? (**Activity 1.1**)	• measure and compare water use for self and other family members, analyzing the difference between need and actual use (**waste**). • identify the nature and origins of types of air pollution prevalent in the home, neighborhood, and community. (**smoke, asbestos, paints, etc.**)
B. Soil/Land – Waste disposal problems have reached proportions which seriously limit our use of the land and threaten our health and well-being.	Explain how refuse, sewage, and chemical contaminants represent a serious disposal problem which threatens health, threatens soils and water resources, and usurps land.	• report on the status of solid or chemical waste disposal conditions in the community.
C. Noise – Excessive noise threatens our well-being and may even alter our behavior.	How does excessive noise affect our well-being?	• describe the impact of environmental noise on social behavior.
II. Resources		Students will be able to:
A. Renewable – The renewable resource base can be extended by reproduction, growth, management, and recycling.	What is the difference between renewable and non-renewable resources? Relate the significance of this distinction to the matter of fossil fuels and society's energy needs.	• define and identify renewable and non-renewable resources. • rank resources in priority order to determine the relative importance of each.
B. Non-renewable – The non-renewable base of mineral elements, for example, is considered finite, and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and recycling.	Of the resources commonly used in the community, which are available locally and which must be imported? What kinds of social and environmental impact has occurred as a result of the use of renewable resources? Non-renewable resources?	• Imagine how resources availability could affect the governmental policies of, and trade among, the nations of the world. • Give examples of, and describe both, social and environmental impact associated with the use of renewable and nonrenewable resources in the community.
C. Reclamation – The reclamation of resources through recycling and reuse is absolutely imperative in a world of increasing population and dwindling resources.	How significant are resource reclamation practices (i.e., recycling, returnables, reuse) when considering resource limits?	• Compare the relative values of the costs and benefits associated with reclamation programs in the neighborhood, community, or city.
III. Energy	How does energy affect international policies?	• name and describe an international incident in the past decade which was caused by one or more nation's policies related to oil production or supply.

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
A. Supplies – Energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.	Which are the wealthiest nations in terms of energy resources?	• explain how energy wealth in certain nations influences trade, development, and foreign policy.
B. Storage – Potential energy is stored energy an object has due to its position or condition.	What natural and human-managed processes are involved in storage of energy resources (i.e, as potential sources of energy)?	• identify and describe the basic processes involved in the storage of energy resources commonly used in the home and community.
C. Transportation – Fossil fuels are most commonly transported by pipelines, barges, trucks, and trains.	What are the most common mechanisms used in transporting energy from place to place?	• compare the means of transporting energy resource materials, both potential energy and actual or kinetic energy.
D. Generation – The most common types of energy generation are the combustion of fossil fuels, the movement of water, and nuclear reaction.	How efficient are machines in terms of the percentage of energy which is converted to work?	• compare the efficiency of simple machines.
E. Energy Efficiency – Using electricity is less energy efficient than using direct conversions with primary fuel sources.	What kinds of factors can and do influence the relative efficiency of the generated energy which you use daily? (**Activity 1.3**)	• compare the relative effects of factors involved in two common energy pathways on the relative energy efficiency of those pathways.
F. Conservation – Conservation implies wise use of energy resources by curtailment, better matching of energy uses to energy sources in order to decrease waste, and improvement in efficiency.	How significant is the process of energy conservation when considering the distribution of energy supplies, and the relative efficiency of energy usage?	• research national level, energy policy statements made during the past 15 years.
IV. Population		
A. Distribution and Density – The ten largest countries now account for nearly 70% of the world's population. By 2000, eight of the ten most populous nations will be developing countries.	How does the distribution and density of world population affect resources allocation, health, food supply and lifestyle? (See **Appendix C**, page 63, "The Population Challenge.")	• describe the impact of population growth on resources.
B. Migration – The reasons for human migration are now related primarily to famine, war, terrorism, and politics.	What are the primary social and environmental conditions which both influence and result from human migration patterns?	• identify and describe the primary conditions which influenced and resulted from an international incident involving human migration during the past decade.
C. Growth Rate – Populations stop growing when children are born at the same rate that people die and net immigration equals zero.	The present world population is five billion; in 12 years it will be six billion. What is the significance of this? What are the primary social and environmental conditions which affect a nation's human growth rate?	• describe the possible consequences of a predicted rise in world population on natural resources in terms of society and the environment. • discuss the influence of one social and one environmental condition on a nation's projected growth rate (i.e., as obtained using the formula for geometric progression).

C. ACTIVITIES

1.1. WATER REQUIREMENTS AND USAGE

Objective: To understand how much water we need and compare it to how much we use

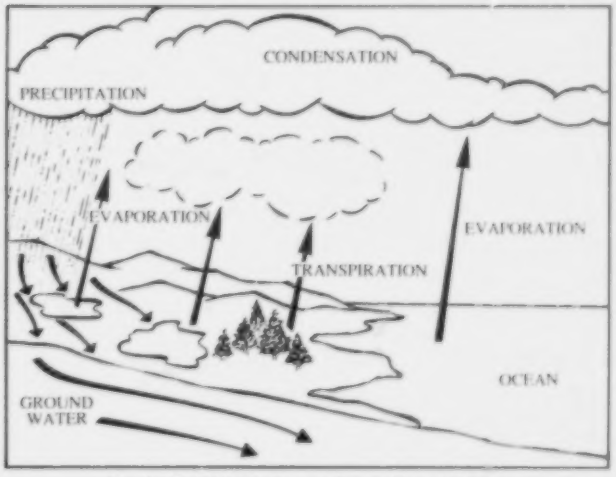
Procedures:

A. Explain how humans get water and what human requirements for water are.

- How much of the human body is water?
- What percentage of total body weight does water represent?
- How much water must be replaced daily in the human system? **(2.5 liters)**
- How much of this is taken into the body by drinking? **(1.3 liters)**
- How do we obtain the remainder?

B. Determine the amount of drinking water needed during a lifespan of 70 years.

C. Illustrate the water supply system in your home, tracing it to its source. (New York City students should understand their reliance on "upstate" watersheds.)



Adapted from: Food and Agriculture Organization, Provisional Indicative World Plan for Agricultural Development, vol. 2 (Rome: 1970), p. 491.

Figure 1.1 Hydrologic Cycle

D. Relate the source of water in your home to the hydrologic cycle. **(Figure 1.1)**

E. Determine your own household water usage and compare it with the information in Table 1. Check the accuracy of the table estimates by comparing them and your own use figures with those of some neighbors.

Table 1

DAILY WATER USE IN THE HOME

Dishwashing	37.9 liters
Toilet (1x)	11.4 liters
Shower	76.9 liters
Bath	115.2 liters
Clothes Washing (one load)	76.9 liters

NOTE: 1 gal. = 3.79 liters; 1 liter = .26417 gal.

F. Determine water use during a one-week period in the home. How much is used for cooking, washing, bathing, and waste disposal?

- Compare estimated totals to actual water meter data if available.
- Is any of this water wasted? How?
- Can you and your family reduce your water consumption without a drastic change in life-style? Why should you?
- Is water a renewable resource? Explain.
- If water is considered to be a renewable resource, why is it that some parts of the world experience shortages or problems with the water supply?

1.2 AIR POLLUTION

Objective: To learn about the nature of air pollutants, their sources, and their effects

Procedures:

A. Distribute birthday candles to teams of students. After lighting the candles, the students should make as many observations as possible on the burning candle.

- What is required for the candle to burn?
- What is the source of this gas for the burning candle? Does the candle burn completely?
- What materials are emitted or remain after the candle has burned for a while? Where do these emitted materials go? What happens to them?
- How is energy used? Is it truly consumed?
- Explain how these questions can be answered by simple observation of a burning candle.

B. Investigate the content of the major components of clean, dry air (nitrogen 78%, oxygen 21%, carbon dioxide 0.03%). Investigate the major sources of these components and their major uses.

- How much air do you personally require during a 24-hour period? Conduct an experiment in which you measure the number of inhalations per minute (do this several times to get a good average). Measure the volume of one "normal" breath of air (displace water from a large bottle).

C. Have students determine the population of a given area of your city or town. They should contact the Mayor's Office, Department of Highways, Planning Department, and the Zoning Department for information on parks and green spaces in the area.

- How much green space is there per citizen in that given area? Devise a plan to determine this ratio.
- How accessible are these green spaces to the elderly and disabled?
- Consider this fact: the total oxygen requirement of a community of 1,000 people (including using fuels for heating, autos, etc.) can be balanced by a 440-acre park. The green space will "use up" carbon dioxide and release oxygen to the atmosphere.
- What percentage of the total urban land you investigated is developed as park land? In your opinion is there an even balance between the oxygen-carbon dioxide cycle for that space? Support your opinion with data and facts.

D. Divide the class into research teams to investigate the components of air which are considered air pollutants. Each team should report on the structure of the pollutant, emitting source, effects on the environment, effects on human, plant, and animal health and the current controls and standards pertaining to the pollutant. The teams should present oral and written reports on their findings. Groups should be assigned to investigate carbon monoxide, sulfur oxides, nitrogen oxides, particulate matter, hydrocarbons, ozone, aerosols, lead, fluorides, and asbestos.

We pay a price in pollution for every bit of energy we use. The less we waste, the more we will gain in smog-free air and pure water.

E. Elicit from students a listing of the six major air contaminants. (Information about "Air Contaminants" and "The Sources of Air Pollution" from pages 6, 7, and 8 of *It Stacks Up,* New York State Department of Environmental Conservation, is provided in Appendix C on page 101.)

- What other sources of air pollution are there in addition to industrial?
- Which contaminants come from each source? Prepare a chart showing contaminants and sources.
- What are the major factors which influence the air quality in your region?
- What is being done to improve the air quality and what else could be done?

1.3 EFFICIENCY

Objective: To learn about energy efficiency through demonstration and observation

Procedures:

A. Review with (or introduce to) the class the scientific definition of efficiency. Duplicate, or make a transparency of, the graph provided below. Discuss what happens to most of the energy which is wasted.

B. Invite a representative of the nearest energy/utility company (NI-MO, LILCO, e.g.) to speak to the class about the efficiency of various types of energy systems. Ask questions about waste and improvements in efficiency.

- How does the substitution of electricity for fuels, such as coal and gas, affect the use-efficiency of our natural resources?
- What are the environmental effects associated with each phase of the nuclear fuel cycle (e.g., the effects of waste heat on water into which it is discharged?)
- Of the items included in Figure 1.2 shown on the next page, which is the least efficient? Why?
- Using the same figure, and the knowledge that the average American home uses 18 percent of its total electrical consumption (kilowatt-hours) annually for lighting, calculate the economic waste involved. (Have students read a utility bill to determine the cost per kilowatt-hour.)
- Consider what might happen to the Hudson River Valley area if the temperature of the Hudson River were increased to 37° Celsius and maintained at that temperature over a period of time.
- Hold a laboratory thermometer over, but not touching, light bulbs of different wattage. What is the thermometer reading for a 40-watt bulb? For a 60-watt bulb? For a 100-watt bulb? How can this wasted heat cause further energy loss during the summer? (**Air conditioning, fans**.)

C. Simple machines can be used to demonstrate the concept of efficiency. Have small groups of students determine the efficiency of inclined planes with different surfaces (rough to smooth) and pulley systems.

- Compute the input and output of each machine. What is the loss of energy in each case?

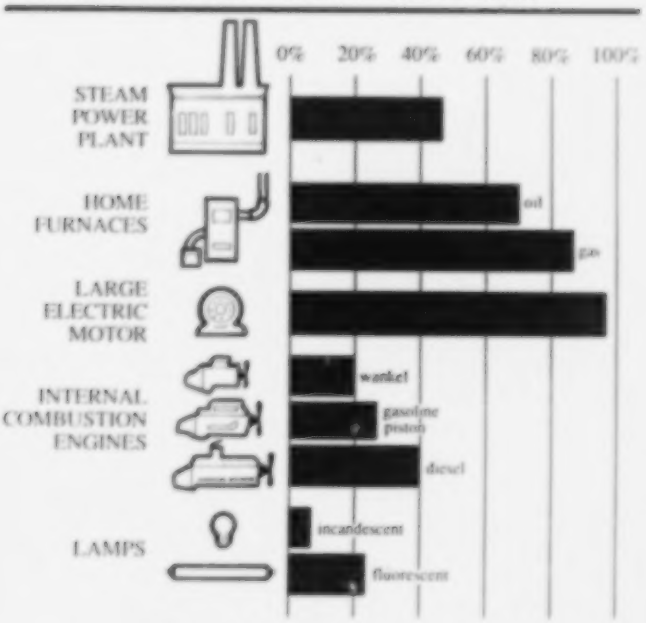


Figure 1.2 How much energy is lost?

- How is the efficiency of a machine determined? (See reference to Miller, G. Tyler, in Appendix B., page 61.)
- List several ways in which efficiency can be increased. What factors decrease efficiency?
- What was the maximum efficiency (percentage) obtained for each simple machine?

Expand the discussion to include more complex machines.

- Give as many reasons as you can to explain why some automobiles run 30 miles on a gallon of gasoline while others run only 12 miles on a gallon. Why is it important to get maximum mileage?
- Explain why better-paved roads might improve the gas consumption of automobiles. Is this increase significant in terms of conserving fuel? Explain.

Using the diesel engine as an example, ask interested students to investigate the following and report their findings to the class.

- percent of available fuel energy used in producing useful work
- recent research which suggests ways of increasing the efficiency of the diesel engine
- extent of the available supply of diesel fuel
- reasons for the increase in the cost of diesel fuel
- ways of conserving diesel fuel supplies

ISSUE 2

SCIENCE AND CRIME

Issue Two

SCIENCE AND CRIME

A. BACKGROUND

When crime is allowed to go unchecked it presents problems that affect the individual, the local community, and the entire nation. The aberrant behavior that spawns criminal acts and the flourishing crime rate threaten the very fabric of our society.

Every civilization has been victimized by crimes of all sorts against both persons and property. In the United States there is a strong feeling, supported by an avalanche of evidence, that the problems of crime are getting worse and attempts to prevent crime have not kept pace. Too many of us are wary of walking the streets, afraid to leave our homes unguarded, fearful of strangers and unfamiliar situations, and suspicious of the quality of products and services that we pay for.

Historically, scientific matters associated with crime detection were almost solely the province of pathologists who carried out "non-medical" investigations. Today, criminal investigators are assisted by a variety of forensic specialists selected according to the needs of the problem at hand (forensic medicine: a science that deals with the relation and application of medical facts to legal problems).

A case of murder, for example, could initially involve a medical examiner who certifies death and makes a preliminary examination of the body. The medical examiner completes the onsite examination and arranges for the body to be moved to a morgue where a post mortem or autopsy can be performed. Meanwhile, police photographers record and document the crime scene, while another investigator sketches the scene showing, in accurate detail, the dimensions and locations of all objects having a bearing on the case.

Interrogators and police artists gather information from eyewitnesses and suspects, while other members of the investigation team gather the medical and dental records of the victim. A specially trained team conducts a systematic search for physical evidence. Physical evidence can be anything from massive objects to microscopic traces of material. Many items of evidence are obvious, but others may be detected only through examination in the crime laboratory. For example, minute traces of blood may be discovered on garments only after a thorough testing in the laboratory; or the presence of hairs and fibers may be revealed in vacuum sweepings or on garments only after close laboratory scrutiny.

As a matter of routine, certain items and materials are collected and sent to the forensic laboratory including: victim's clothing, fingernail scrapings, head and body hair, blood (for typing purposes), recovered bullets and weapons from body and crime scene, swabs of various body fluids, samples of collected body tissues, lifted fingerprints, and other physical evidence linked to the crime (e.g., drugs, broken glass, castings of tire or shoe prints, documents, paint chips, petroleum products, powder residues, serial numbers, soil and mineral samples, tool marks, and wood and other vegetable matter.)

The examination of physical evidence by forensic scientists is usually undertaken for purposes of identification or comparison. The forensic scientist must determine those properties of the material in question that give it a unique identity. Properties are the identifying characteristics of substances, both physical and chemical.

Physical properties generally describe a substance in quantitative and qualitative terms. For example, weight and mass, volume, density, refractive index, hardness, fracture patterns, birefringence, boiling point, and melting point are typical quantitative descriptors that can be measured using various methods and scientific apparatus. Odor, color, taste, and texture are several qualitative properties of matter. Chemical properties describe the behavior of a substance when it reacts or combines with another substance.

One of the more routine crime laboratory procedures is the use of indicator solutions to test for the presence of various substances. For example, the Marquis reagent is used to detect heroin and the luminol test indicates the presence of blood. Iodine fuming is used to indicate the presence of certain compounds found in perspiration, thus leaving a purplish-brown trace of a fingerprint. Chromatography is used to separate the constituents of multi-component specimens such as drugs, dyes, and poisons. Spectrophotometry is used to identify substances by their selective absorption of ultra-violet, visible, or infrared radiation.

Forensic scientists incorporate the vast knowledge derived from the disciplines of pathology, anatomy, serology, histology, and toxicology, along with a whole array of

scientific instruments and techniques related to the understanding of human tissue. The most commonly used instrument is the microscope and its various forms, including the compound microscope, the comparison microscope, the stereoscopic microscope, the polarizing microscope, and the scanning electron microscope. Surgical and micro-dissection tools, and a variety of other technological aids including breathalyzers, X-ray equipment, and blood analyzers are frequently used in the investigation of a crime.

The detailed collection of data provided by investigators and forensic scientists often leads to the unraveling of a crime. Because their work may ultimately be a factor in determining a person's guilt or innocence, forensic scientists may be required to testify with respect to their methods and conclusions at a trial or hearing. It is not the responsibility of the forensic scientist to render any judgment based on the data collected. However, the courts expect forensic scientists to offer opinions that are based on reasonable scientific certainty. The forensic scientist should not be an advocate of one party's cause, neither the defense nor prosecution, but only an advocate of truth.

Through the study and practice of the techniques of criminal investigators and forensic scientists, students will experience a relevant, real-world application of the problem-solving and process skills of science. While they attempt to solve some of the problems connected with crime, students will encounter a vast amount of science knowledge. In addition the students will become aware of the many careers in the field of criminal investigation and forensic science.

B. *Issue Outline*

Content Outline	Key Questions	Performance Objectives
I. Dealing with the Problems of Crime		Students will be able to:
a. Crime investigation and prevention are demanding activities that involve science and technology	How does crime affect your daily life? What are the jobs and careers in the field of crime investigation?	• to learn about the extent of crime in their community and what law enforcement organizations are doing to prevent crime by interviewing local authorities. • use newspaper classified sections and vocational handbooks to learn what jobs and careers are available and what training is necessary for each.
b. There are many practical, effective methods of protecting oneself and one's property from crime.	What can you do to protect yourself and your property from crime? How can the disabled and elderly protect themselves and their property from criminals? **(Activity 2.1)**	• create a pamphlet containing a variety of crime prevention tips compiled from interviews and publications. (Include information pertinent to the needs of the elderly and disabled.)
II. Solving Crimes through Science		Students will be able to:
a. Criminal investigation requires an accurate recording of the crime scene.	What steps are taken to thoroughly record a crime scene?	• measure and sketch a scale model of a mock crime scene showing location and dimensions of all crime-related evidence.
b. Positive identification of criminals and unknown bodies is possible through the use of a variety of scientific techniques.	What techniques are used to identify criminals and deceased victims?	• record notes pertinent to the investigation of a mock crime. • photograph a mock crime scene and evaluate the usefulness of the photos. • devise a system for retrieving and organizing crime-related data.

Content Outline	Key Questions	Performance Objectives
c. Eyewitness descriptions must be communicated, recorded, and interpreted as precisely as possible for purposes of understanding the events of the crime and the identification of the person committing the crime.	What can you do to increase your skills as an eyewitness? What procedures are used to systematically search a crime scene? **(Activity 2.2)** How can the physical properties of matter be used to classify and identify unknown substances?	• assemble an 'IdentiKit' and use it to develop the skill of eyewitness identification. • plan and conduct a systematic search of a mock crime scene for purposes of collecting physical evidence. • demonstrate techniques used to collect physical evidence such as fingerprints, classify them according to type, and identify the owner(s).
d. Techniques of Criminal Investigation include:		Students will be able to:
– Careful observation and a systematic search of the crime scene for the purpose of collecting physical evidence. – Examining, identifying, and classifying physical evidence.	Refer to the "Mystery Powder" activity in the Elementary Science Study materials, Delta Publishers, Nashua, NH.	• identify an unknown substance by measuring its physical properties and comparing those to values of known materials. • identify the presence of certain classes of compounds by using indicator solutions. • determine the presence of blood, and 'type' a sample of human blood.
– analysis of the physical and chemical evidence by forensic scientists.	What are some chemical tests that can be used to identify unknown substances?	• use a microscope to examine various hair samples and determine their origin.
– autopsies of deceased victims to determine cause of death.	What is the role of the Medical Examiner in a criminal investigation?	• recognize cause-and-effect relationships that are revealed by an investigation of events.
– interpreting investigation results to produce inferences, hypotheses, and deductions that may help solve a crime.	What critical thinking skills are required to solve a crime?	• make reasonable inferences based on collected data. • propose hypotheses and logical conclusions that can be derived from the findings of an investigation. • communicate findings of investigations in written, graphic, and pictorial form.
III. Sociological Implications of Crime and Criminal Behavior		Students will be able to:
a. Various theories have been offered to explain the causes of crime and criminal behavior including:		• analyze the data collected from a self-report survey. • react to a filmed documentary warning individuals to change their criminal behavior.
– Delinquent tendencies are caused by low self-esteem. – Criminal behavior is learned behavior. – Criminal behavior may be influenced by a person's genetic make-up	How can you determine a person's level of self-esteem and delinquent tendencies?	• research and report on the possibility of genetic influence on criminal behavior. • discuss the implications of the Calhoun study of overpopulation of rats, as it relates to aberrant social behavior.

Content Outline	Key Questions	Performance Objectives
– Environmental conditions such as overpopulation may cause problems associated with crowding and encourage criminal behavior.	How do you think that excessive noise in the environment might affect one's social behavior? (aggression) Can "noise" be helpful? (soothing music)	• indicate the characteristics of a successful detective after reading classical examples of literature based on criminal themes, such as "The Murders in the Rue Morgue" by Edgar Allen Poe, or the Sherlock Holmes adventures by Sir Arthur Conan Doyle.
a. There are correlations that can be demonstrated between crime rates, locations, and economic/or living conditions.	What is the relationship between the distribution of wealth in a community and the local crime rate?	• learn the legal definitions of the terms used to describe various crimes.
c. Criminal themes and vocabulary have influenced our literature and daily language.	How has crime affected our literature and language? **(Activity 2.3)**	• write a short story using the vernacular of the "underworld."

C. ACTIVITIES*

2.1 DEFLATING CRIME**

Objective: To discover and record some ways of preventing crime

Procedures:

a. Refer to the following crime prevention tips and discuss in class the information listed. (Duplicate and provide copies to students.)

b. After reading and discussing the crime prevention material, answer the following questions. Refer back to the information sheet only when necessary. Record the answers.

- Why should the overhead dome light in your car be kept in working condition?
- How should single women have their names listed in the phone book? Why?
- Why is it unwise to put your name and/or address on your house keys?
- Why is it unwise to display your name on your mailbox (home, not apartment building)?

c. If an officer from the police department visits your class, the information sheet can serve to focus discussion questions.

d. Using all of the accumulated crime prevention information, design and prepare a pamphlet on the subject which can be shared with family, friends, and members of your community.

e. Review the slide tape presentation entitled "You Can Protect Yourself" which was developed by Peoples' Inc. during a grant funded by the New York State Office of Crime Prevention. This slide/tape presentation was designed to help the disabled protect themselves from crime. It can be ordered from Peoples' Inc., in Buffalo, NY, (716) 838-4444. Have the class prepare a pamphlet on this subject which can be shared with family, friends, and members of the community who are disabled.

Crime Prevention Tips

Crime continues to be a major national problem. If allowed to increase unchecked, your chance of becoming a victim (if you have not been one already) becomes greater. It doesn't matter where you live . . . city, suburb, or in the country. In fact, crime is increasing at a greater rate in the suburban and rural areas of our nation than in the cities.

But there are ways – simple, logical ways – you can protect yourself and your family from crime. That's what these tips are all about . . . simple but sharp !ittle pointers which you can use to DEFLATE CRIME in your commu-

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* The activities in this section are adaptations of those found in the Crime Prevention Unit of the Rochester City Schools' Unified Science Education (U.S.E.) program. Copies of this material may be purchased from the school district by writing to Rochester City Schools, 131 West Broad Street, Rochester, NY 14608.

** The information in this activity is adapted from "Points for Deflating Crime" which is provided by the 1,200 Exchange Clubs of America as part of their continuing program of crime prevention.

nity. For that's what it takes to puncture the ballooning crime rate . . . individual effort by every citizen. By practicing the simple precautions listed in this booklet, you can do just that . . . protect yourself and simultaneously aid in a national effort that is essential if crime is to be controlled.

YOURSELF

Crimes of violence are increasing, according to recent FBI Uniform Crime Reports. Incidents of murder, rape, and assault occur in cities, suburbs, and rural areas alike. Although, statistically speaking, you are more likely to be a victim of a violent act if you live in a highly populated area, no one is absolutely safe.

Protecting yourself is a matter of preventing the situation before it happens. Following the rules already outlined will drastically reduce the possibility of your being in a harmful situation. Many incidents of murder and assault occur in a situation out of police control. What this means is that these offenses are more likely to take place within the family or between persons well known to each other. Felonious assault and murder, offenses that occur during a robbery, gangland slayings, or during other criminal activity, account for a small percentage of the total crimes in this category. Thus, preventing a crime before it happens by making yourself and your property a difficult target, also prevents a situation from arising which may cause you bodily harm.

CHILDREN

Here are some pointers that young grade school children should understand and follow. Make sure that your younger brothers and sisters and children in your neighborhood are aware of the reasons for these tips.

1. Remember that the police officer is your friend. Get to know him, and rely on him whenever there is trouble.
2. Never accept a ride from a stranger.
3. Don't take money, candy, or gifts from strangers.
4. Don't talk to strangers.
5. Don't play alone in alleys or near empty or deserted buildings.
6. Don't enter any buildings or rooms with strangers.
7. Do report to your teacher or a policeman any stranger who wants to join in your play.
8. Do report anyone loitering near school areas to your teacher or to a policeman.
9. Do write down the license number of the car of any stranger who takes one of your friends for a ride.

YOUR HOME

Most burglars are "amateurs" and thus lack the skills of a pro. The amateur must find an easy target. If you use the procedures given here, your home will be too difficult a mark. Remember, home is where you live . . . don't invite trouble?

1. WHEN AWAY, MAKE YOUR HOME LOOK AND SOUND OCCUPIED. A variety of inexpensive timing devices are available which will turn your lights or a radio on and off during the nighttime hours. **(Try to design your own systems or features which will make your house look occupied. Burglars don't like sound and lights.)**
2. MAKE SURE YOU HAVE GOOD LOCKS AND USE THEM. The best method of testing some types of locks is to open the door and push in the lock button. Now try to push in the bolt. If the bolt can be moved in, it's not safe! A burglar could easily insert a credit card and open the door. Have a licensed locksmith install a deadbolt lock.
3. NEVER PUT A NAMETAG ON YOUR HOUSE KEYS. If you lose them, you'll have an unwelcome visitor in no time.
4. DON'T DISPLAY YOUR NAME ON A MAILBOX OR PLAQUE. A burglar could easily look up your phone number in the director . . . phoning ahead is a favorite method of "casing" a victim to see who is home.
5. IF YOU HAVE SLIDING GLASS DOORS, MAKE SURE THEY LOCK PROPERLY. This type of door is a favorite point of entry. They can be easily locked with an old broom handle sawed off to fit and then placed in the track. **Compare standard glazing to shatterproof, wired glass or other such products.**
6. DON'T KEEP LARGE AMOUNTS OF MONEY AROUND THE HOUSE. If a burglar does break in, don't reward him with easily accessible cash or jewelry.
7. IF YOU CAN HAVE A DOG, DO. A barking dog can arouse suspicion. Why should a burglar take the chance when there's a quieter home just down the street? **(Devise an alarm system that uses a recording of a barking dog.)**
8. HELP YOUR NEIGHBOR. Agree to keep an eye on each other's homes. If you see something suspicious, call the police. Do not endanger yourself.
9. IDENTIFY YOUR VALUABLES. Many communities have identification procedures in cooperation with the local police. They are usually numbers which can be easily traced and make your television, radios, etc. less valuable to a thief. It's also a good idea to keep a list of all credit card numbers. The list will be invaluable if your cards are stolen. **(Discuss and compare various methods of adding identification markings to valuables; diamond or carbide "pens," engravers, etching, etc.)**

YOUR AUTO

You may be surprised at the number of people who still don't protect their automobiles from thieves. If you follow these convenient and easy rules, your auto is less likely to be stolen or vandalized.

1. NEVER LEAVE YOUR KEYS IN THE CAR. Even when leaving your car with a parking attendant, allow him to keep only an ignition key.
2. USE ALL ANTI-THEFT DEVICES. The locking steering wheel and buzzing key reminder are designed to protect you . . . be glad you have them! (**How do these devices work? Design your own security system.**)
3. MAKE SURE THE CAR IS COMPLETELY LOCKED BEFORE LEAVING. This includes the vents as well as the doors. Also keep window seals in good repair. Good window seals make it difficult for a thief to slip a coat hanger past the window to unlock the door.
4. KEEP YOUR OVERHEAD DOME LIGHT WORKING. At night, this simple device may attract attention when the car door is opened.
5. PARK IN WELL-LIGHTED AREAS. This protects both you and your car. If at home, always park in your driveway or garage.

Summary

- Cooperate with and support the law enforcement agencies in your community. Instill a greater respect for law enforcement officials in your friends as well as your children so that police not only can be more effective, but can also help make you safe!
- Participate in community law enforcement programs. If programs don't exist, then start your own community group. Contact your local Exchange Club, Law Enforcement Agency, Neighborhood Watch Society, or other service organizations for assistance. These kinds of programs not only help make your community "criminal proof" but foster stronger community relations.
- The following simple rules could save your life. They are designed for both men and women.

1. WHEN RIDING IN YOUR CAR, KEEP THE DOORS LOCKED AND THE SEATBELT ON. The seatbelt not only helps in an accident but can keep you from being thrown from your auto.
2. DON'T CARRY LARGE SUMS OF MONEY. If you must, don't advertise the fact. There's no reason to reward the robber with a full wallet or purse!
3. IF YOU LIVE ALONE, DON'T ADVERTISE IT. Single women should list their names in the phone directory with first and middle initials and last names only: Duncan, J.A. not Duncan, Janet A.
4. NEVER OPEN YOUR DOOR TO STRANGERS OR UNIDENTIFIED PERSONS. Always ask repairmen or deliverymen for identification. It's strongly suggested you have a "peephole" or other means of identifying a caller other than opening the door.
5. DETERMINE WHICH OF YOUR NEIGHBORS YOU CAN COUNT ON IN CASE OF TROUBLE. Neighbors can be the greatest help on Earth!
6. IF ATTACKED, SHOUT "FIRE" RATHER THAN "HELP" OR "RAPE" - it elicits a better response.
7. ON A BUS, SIT NEAR THE FRONT. ON SUBWAYS, BE ALERT; don't go to sleep. **(Discuss how disabled persons are highly visible targets in these situations.)**
8. KNOW YOUR ROUTE HOME. Note the location of stores that are open late, buildings with doormen, fire and police stations. Avoid alleys, dark parking lots, and streets, and parks.
9. ABOVE ALL, DO NOTHING WHICH WOULD JEOPARDIZE YOUR PERSONAL SAFETY! If approached, cooperate fully. If a robber displays a firearm, consider it loaded. Do whatever necessary to insure your physical well-being. You might lose some money, but you will save your life.

These are suggestions which you can use to DEFLATE CRIME in your community and decrease your chance of joining the growing list of crime's victims. Crime usually preys on the unsuspecting and the unprepared. The key is to take action before a crime has a chance to occur.

2.2. YOU WON'T FIND THIS FILE BAKED IN A CAKE

Objective: To understand the need for good identification techniques in the apprehension of criminals

Police make extensive use of computers these days, which allows them to store and quickly retrieve large amounts of information. The file to be made in this activity will contain only a relatively small amount of information, but simply making the file reveals much about how information can be handled efficiently.

In the 1800's, before finger printing was used, criminal identification was accomplished by making a number of measurements. The technique was known as the Anthropometric System, and was originated by a Frenchman named Bertillon.

Procedures:

A. Obtain a yardstick and, with the help of a partner, make the following measurements in inches and record them:

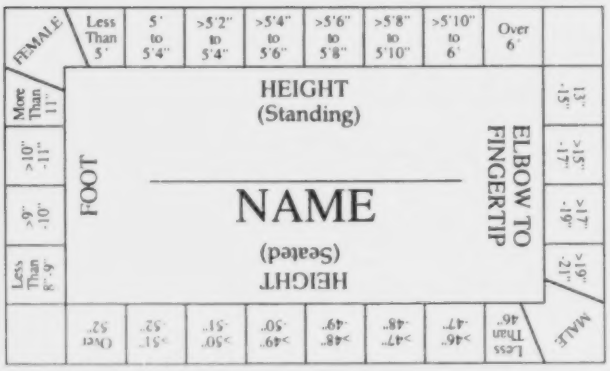


Figure 2.1

- your height (standing)
- your height (seated) NOTE: Everyone should use the same kind of chair for this.
- the length of your foot
- the distance from your elbow to the tip of your middle finger

Record these measurements on the 3" × 5" form provided (See Figure 2.1 above; reproduce copies for students) by making "x's" in the appropriate boxes (> means greater than).

B. Staple the form to a 3" × 5" card. Use a paper punch to make a hole through each "x" you have made on the card.

Use scissors to cut out all of the boxes that have not been punched. Your card should look similar to the one in Figure 2.2.

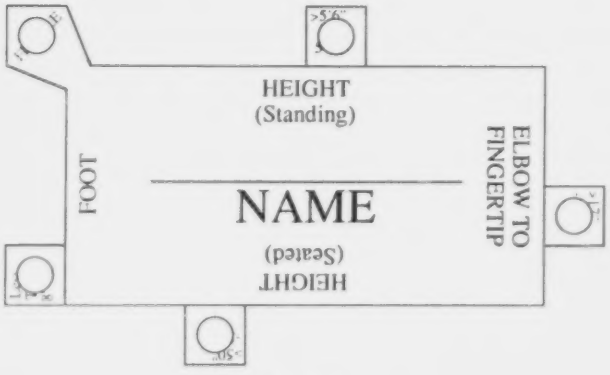


Figure 2.2

C. Turn in your completed card. The teacher will put it in a neat stack together with the cards from the rest of the class. Then a student will volunteer to take the stack and, as the teacher gives the measurements of previously selected but unnamed student, the volunteer will push a dowel or similar instrument through the corresponding holes in the stack of cards. As the stack is gently shaken, all the cards not held by the dowel will remain. If this procedure is repeated for each measurement, eventually only the card(s) containing the measurements of the selected person will remain.

D. Answer the following questions:

- Is there more than one person with the same measurements in your class?
- How could the accuracy of this method be improved? (**Fractions, metric measurements, more measurements**)
- Would this file be good for identifying a criminal from an eyewitness description? (**No! Not accurate enough**)
- When would a description involving these measurements be useful in identifying someone? (**For identifying corpses or prisoners**)
- What is the physical characteristic most often used by police to identify people nowadays? (**Fingerprints. Investigate and report on "voice-printing" technology.**)
- What is a better way to store information? (**Computer**)

(When appropriate, use metric measurements, or convert to metric.)

2.3. SAY WHAT?

Objective: To understand the impact that crime has had on our language and literature.

Criminals have developed a mini-language of their own to express certain ideas and information about their lifestyles and activities. This language is constantly changing and, if Al Capone were alive today, he probably would have a hard time communicating with modern hoodlums.

Procedure:

A. Choose at least 10 terms from the "Crook Book" list on the following page and substitute slang currently in use that has the same meaning. (Students will find most of the terms unsufferably corny, but remind them that their job is to update it.) For instance, the term "bull" is hardly ever used to describe a police officer these days.

- What word is commonly used today?
- Record these 10 terms and their modern equivalents and their meanings.

B. Choose a dozen or more terms from the "Crook Book" and/or your own list and use them to write a short story about crime.

C. After you have tried to write the way these people speak/spoke, consider the following:

- Why do you think criminals have developed a vocabulary of their own?
- Why does a detective or a policeman need to have a knowledge of criminal slang?
- Why is it helpful for anyone to have this knowledge?
- How did the use of slang rather than regular vocabulary change the type of story you wrote?

CROOK BOOK

1. **action** – betting or gambling
2. **bag** – woman of poor appearance
3. **beef** – complaint or to complain
4. **big house** – penitentiary
5. **bit** – term in prison
6. **bite** – sum of money, sometimes protection payment made to racketeer.
7. **blow** – leave hastily, run away
8. **book** – maximum sentence
9. **booster** – shoplifter
10. **box** – a safe
11. **brass** – fake jewelry
12. **buildup** – preparatory work for a crime
13. **bull** – police officer or detective
14. **bull pen** – large cell for safekeeping of prisoners
15. **bum steer** – false information
16. **buried** – a witness who accepts money to leave town until after a trial.
17. **cluck** – victim of a crime, a stupid person
18. **collar** – arrest
19. **con** – to swindle or cheat, can also mean a convict
20. **copping a plea** – pleading guilty to a lesser charge
21. **crib** – a safe or a bed
22. **croaker** – physician
23. **dick** – detective or plain clothesman
24. **dip** – pickpocket
25. **D.O.A.** – dead on arrival
26. **drop** – temporary place to hide stolen property
27. **enforcer** – person who kills and tortures other criminals for gang bosses
28. **fall guy** – person who is framed for a crime
29. **fan** – to locate a wallet by lightly touching someone's pockets
30. **gravy** – easy money
31. **heater** – revolver or pistol
32. **grifter** – small time gambler
33. **fence** – receiver of stolen property
34. **heeled** – carrying a revolver or pistol or having money
35. **hush money** – a bribe paid to insure silence
36. **incendiary** – person who sets fires
37. **jug** – prison cell
38. **lam** – to run away
39. **in the bag** – everything is arranged or all set
40. **meatball** – an easy victim for a criminal
41. **mechanic** – skilled, professional criminal
42. **passer** – person who passes bad checks
43. **office** – a quiet or silent signal from one criminal
44. **mouthpiece** – an attorney for a person accused of a crime
45. **pigeon** – informer
46. **pineapple** – bomb
47. **put on the spot** – mark for killing
48. **potsie** – a police shield or badge
49. **snowbird** – dope addict
50. **take a powder** – command to leave; leave

ISSUE 3

DISASTERS

Issue Three

DISASTERS

A. BACKGROUND

A peaceful evening in the community is suddenly marred by the strange behavior of farm animals and family pets. Shortly thereafter, faint tremblings of the earth become vibrations in buildings as lamps sway and ceilings crack. What should people do? Should they run outside, hide in the basement or attic, or remain in place? What is the recommended behavior during an earthquake?

A nuclear power plant is scheduled to be built in your area. Some people are strongly in favor of the plant, stating it will drastically cut the cost of electricity. Others agree that nuclear power is dangerous. They point to the accidents at Three Mile Island and Chernobyl as examples of our inability to handle nuclear energy and radioactive materials. If a nuclear accident were to occur in your region, would you know what to do? Do you know the short and long-term hazards of nuclear radiation?

These examples are only two of the many natural and technological hazards that individuals may encounter during their lifetimes. Even a casual acquaintance with some of these dangers of everyday life and the measures to cope with them will help to protect your health, your safety, and our environment.

B. ISSUE OUTLINE

Content Outline	Key Questions	Performance Objectives
I. Natural Disasters		Students will be able to:
A. Tornadoes and Thunderstorms – Tornadoes are violently rotating local winds associated with severe thunderstorms.	What is the difference between a tornado watch and a tornado warning? How are thunderstorms and tornadoes related?	• State the difference between a tornado watch and a tornado warning. • explain the relationship between thunderstorms and tornadoes, and know that other hazards such as lightning, floods and flash floods might occur.
	Thunderstorms may occur along fronts, near mountain barriers, and within air masses when warm, humid air is forced upward. What are the warning signs of an approaching thunderstorm? What are the characteristics of a tornado? Thunderstorm? What are the various forms of lightning? – Describe ways in which homes and other structures are protected from lightning damage. – Discuss the use of surge protectors on computers and other devices used at home, school, and work. – List safety precautions to follow to avoid being hit by lightning if you are caught in a storm.	• describe the type of cloud formation associated with an approaching thunderstorm and tornadoes. • estimate the distance to the thunderstorm by counting the number of seconds between the flash and the thunder and dividing by five. (Help them derive the formula.) • list and describe the different types of lightning that could occur in the region. • state what precautions you should take if a tornado is approaching and you are in open country, structures with wide roofs, homes, shopping centers, office buildings, or mobile homes. Discuss the safety precautions that can be taken by disabled persons.

Content Outline	Key Questions	Performance Objectives
	– Describe first aid for victims of lightning. What safety precautions should one take if a tornado is approaching?	
		Students will be able to:
	What are our 10 most important lightning safety rules?	• list at least 10 important lightning safety rules.
	In what part of the country are tornadoes most numerous? At what time of the year?	• locate, given a map of tornado frequency, those states with the most tornadoes and the time of the year they are most likely to occur.
	What effects can tornadoes have on the natural environment?	
B. Hurricanes – Hurricanes are gigantic whirling storms with high winds, torrential rains, and related storm surges capable of causing widespread flooding and destruction.	What are some of the important characteristics of a hurricane.	• describe major effects, and the implications of these effects for emergency planning.
	When and where do hurricanes occur?	• describe several characteristics of all hurricanes.
		• locate on a map the most frequently traveled paths of hurricanes and time of the year they most often occur.
	What do we mean by small-craft, gale and storm warnings? (Introduce Beaufort Scale.)	• explain the difference between small-craft, gale and storm warnings using wind speed and tree movement.
	What effects can a hurricane have on barrier islands, beaches, sand bars, and similar coastal landforms?	• describe how combined wind and water motion can drastically alter landforms and property values.
	What safety precautions should one take as a hurricane approaches?	
	What food, medicine, and emergency items should be available? (**Activity 3.1**)	
		Students will be able to:
C. Floods – Heavy thunderstorm precipitation can bring on sudden flooding.	What atmospheric or geological events lead to the possibility of flooding?	• list safety precautions a family should take from an approaching hurricane. Name the tasks assigned to each family member. Consider what precautions would be taken if a family member were disabled.
	How do human activities help cause flooding?	• describe weather conditions or geological events that could lead to flooding.
	What are the immediate and long-term dangers of flooding?	• describe forestry practices that help prevent flooding. Discuss the value of dams in preventing floods.
	What are the immediate and long-term dangers of locating one's residence on an active flood plain?	• explain flood hazards associated with debris, power failure, heat loss, animal death, broken sewage lines, water pollution, broken gas lines, and fire.
	Why is zoning needed? Who decides on zoning regulations in your area and what is the role of citizens in these decisions? Should variances be granted?	
	What are the flood hazard areas in my region?	

Content Outline	Key Questions	Performance Objectives
	What preparations should I make if a "flood warning" is announced? List those health hazards most likely to occur during and after a major flood?	• describe the relationships among flood plain location, flood hazard, land and property value, and insurance coverage. • locate local flood hazard areas with respect to their school and home. • produce a list of advance preparations needed by a family if a flood warning is announced. • identify major health hazards one would encounter after a flood involving food, drinking water, medical care, building damage, gas leaks, and mud-water damage.
D. Earthquakes – Earthquakes are a shaking, trembling or upheaval of the earth, generally in recently uplifted regions that are bordered by faults.	What are the causes and antecedent conditions of an earthquake? What are the moderate and high risk earthquake regions of New York State? Provide earthquake map(s) of New York State. The United States. How is the strength of an earthquake measured? How can I protect myself during an earthquake? List several "do's and don'ts" for when the earthquake is over.	• explain the geological events that precede and/or produce an earthquake. • outline earthquake risk areas in New York State. • compare the strength of an earthquake reading with physical movement/damage of buildings. • make a list of several types of structural and environmental damage that may occur as a result of an earthquake (bridges, water mains, gas lines, nuclear power plants). • prepare specific steps that one would take to insure a family's safety in an earthquake prone area (gas, electricity, water shut-offs). • instruct family members as to proper safety checks to be used after an earthquake.
E. Winter Storm – Snow, low temperatures, wind, and freezing rain or drizzle are components of winter storms.	How do we define a blizzard, heavy snowstorm, and an ice storm? What is the difference between a winter storm watch and a winter storm warning? What immediate and long-term dangers would one most likely encounter? Make a list of household items to be checked if a winter storm is approaching. What is hypothermia? What are the warning signs? How should one aid the victim?	• define blizzard, heavy snowstorm, ice storm. • state the difference between winter storm watch and winter storm warning. • illustrate by means of a poster the various dangers one might encounter during a winter storm. • prepare a list of items to be collected if a winter storm is approaching. • describe hypothermia in terms of warning signs and emergency treatment. • compare and contrast these warning signs of hypothermia with those observed in a partially paralyzed family member. • describe treatment for frostbite.

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
F. Others (Drought, Extreme Heat Conditions, Forest Fire, Landslide, Mud Flow, Radon Gas Infiltration)	Discuss the following terms: heat strain; heat stroke; heat impairment; sunburn; loss of electrolytes; use of alcoholic beverages; underground utility line breaks; tilting fences, utility poles, etc.; smoke inhalation; use of home swimming pool; safety precautions while camping; chimney cleaning; replanting; fire lanes; protecting roof tops from sparks; and Radon gas (**Activity 3.2**).	• explain how each of the dangers/ hazards are caused and can be mitigated or prevented.
II. Technological Hazards		Students will be able to:
A. Hazardous Materials – Hazardous materials and their safe transport and disposal have become the most serious waste problem we face today.	What do we consider a "chemical spill?" How are "illegal dump sites" hazardous to our health and safety? What transportation routes through the community involve the shipment of hazardous material? What are these materials and what danger to life would there be if an accident occurred? You discover a large container of an unknown noxious solution by the side of the road. What immediate steps should be taken by you, the discoverer, and by community authorities to investigate the situation?	• compile a list of hazardous materials found in their school and at home. • define "chemical spill" and "toxic waste." • explain how "illegal dump sites" are a threat to humans and the environment. Report on laws that have been passed to deal with this problem. • list, after consultation with the local "Civil Defense Office," routes that are routinely used by chemical companies to transport hazardous materials through their community. • prepare a list of steps they should take if they discover a chemical storage container or dumpsite.
B. Radiological Accidents – Radiological accidents, with the proliferation of nuclear reactors and the increasing use of radiation in medicine and industry, have become serious threats in our society.	What are some examples of hazardous materials? What symbols and identifiers are used to mark carriers containing hazardous substances? Describe the various types of nuclear radiation, explaining their hazardous nature. What does the term "radioactive decay" mean? How do we measure the strength of radiation? What are considered safe, relatively safe, and unsafe doses of radiation over time for humans? What signs and warnings are used for the presence of radiation?	• identify common symbols used in marking chemical storage containers. • list three types of nuclear radiation, and, using a Geiger counter, show how various substances reduce the relative hazard to life. Students will be able to: • describe how three different kinds of radioactive materials decay over time and how these decay patterns relate to the material's capacity to produce biological effects (e.g., cesium, uranium 238, plutonium 239). • describe how one would measure various radioactive samples using a Civil Defense Geiger counter.

Content Outline	Key Questions	Performance Objectives
		• develop a chart showing safe and relatively safe doses of radiation for children and adults. • explain how the populace is warned of the presence of radiation.
	What are possible sources of nuclear radiation accidents within 10 miles of our school? What emergency plan does the school have? What is the difference between external and internal radiation hazards?	• list all possible sources of nuclear radiation within a radius of 10 miles of their school. • give examples of possible external and internal radiation hazards.
	You live on a farm or have a home garden. If a nuclear accident occurs, what special precautions should be taken with regard to using milk from livestock or using vegetables?	• give examples of special precautions that one must take with regard to radiation contamination and local water supplies, home gardens, pets and livestock. (Refer to the recent 3 Mile Island and Chernobyl incidents.)
C. Other technological hazards (Dam disasters, resource shortages, structural fire and explosion, domestic disturbances)	What plans does your community have for emergencies? Whom would you contact in an emergency? (**Activity 3.3**)	

C. ACTIVITIES

3.1. DISASTER PREPAREDNESS

One way to protect yourself during a disaster is to be prepared before it happens. You can ready yourself by learning what to do for the specific emergencies that may occur. Another way to protect yourself is by learning the danger signals, so that you will be able to identify trouble when it first appears. Having plans for what to do, where to go, or whom to call for help will improve your chances of survival.

Objective: To identify preparations to be made before a disaster strikes

Procedures:

A. Read "Your Chance to Live," from the Civil Defense Preparedness Agency.

B. Discuss the following questions and record the answers as they pertain to your own situation:

- What areas in my home are suitable for emergency shelter?
- What emergency sources of water are available?
- What type of food supplies should I maintain? Where should they be kept?
- Are there additional clothes and blankets available? Where?
- What are my plans for emergency toilet facilities?
- What emergency medical supplies are on hand? Have prescription drugs and water purification materials been included?
- What additional supplies and equipment will be needed?

C. Prepare a pre-emergency checklist indicating specific family member responsibilities for each anticipated emergency. Use the form "Outline for Family Planning" which follows.

OUTLINE FOR FAMILY PLANNING

Public fallout shelter nearest our home is located at:

The best route from our home to this shelter is:

The best route from our home to this shelter for a disabled person is:

The location in our home that offers the best fallout protection is:

Nearest shelter to work/school:

Best route planned?

Is assistance needed to reach shelter?

Who will provide?

Family member responsible for:

Home shelter area water:

Home shelter area food:

Supplies to take to public shelter:

First aid and first aid kit:

Fire prevention and control:

Safe storage of vital family records:

Sanitation and sanitation supplies:

Maintenance of family shelter area:

Insure battery radio is available and working, and spare batteries on hand:

Turn off burners, close windows, secure house (turn off utilities if told to do so):

_____

Secure area outside house:

_____

Special Responsibilities:

Family pets: _____

Livestock: _____

Farm equipment: _____

Warn neighbors: _____

Special Personal Needs:

Medicines: _____

Foods: _____

Infant supplies: _____

Checklist of supplies for family shelter area:

_____ Water

_____ Food

_____ First aid kit, health and medical items

_____ Sanitation items

_____ Battery radio, spare batteries

_____ Clothing

_____ Firefighting equipment

_____ Special needs of disabled family members

Items we plan to take to public shelter:

_____

_____

_____

_____

_____

_____

We can obtain additional planning information from:

Local Civil Defense Agency _____

Address _____

Telephone _____

State Civil Defense Agency _____

Address _____

Telephone _____

County Agricultural Agent _____

Address _____

Telephone _____

3.2. RADON GAS

It is suspected that hundreds of thousands of homes in the United States may have dangerous levels of radon, a naturally-occurring radioactive gas. Exposure to this gas may increase the risk of lung cancer.

Objective: To investigate the health risk of radon gas in homes

Procedures:

A. Read "Radon Exclusive." (See reference in Appendix B, page 61.) Discuss the health risk of Radon gas. (Review with students the Uranium-Lead Decay Series. Discuss Alpha, Beta particle nomenclature. See reference to Concepts in Modern Chemistry, Appendix B, page 61.)

- What structural conditions permit radon to accumulate?

- How can radon be detected?
- If radon is detected in a basement and removal suggested, what methods are recommended?
- Compare radon gas concentration to the health risks due to smoking.

B. Map the areas of the United States with high Radon concentrations and those with low concentrations.

C. Write to local (town, city, county) and state agencies for data about radon gas. Some local agencies have begun programs in which test kits are provided to homeowners and analysis of readings is available. Try to obtain one or more test kits to be used in the homes of class members.

- How safe are your homes?

3.3 COMMUNITY EMERGENCY PLANS

The Federal government requires that plans be developed to strengthen emergency procedures for areas around nuclear power plants. However, many of these procedures can be applied to storms, fires, chemical spills, and other emergencies as well.

Objective: To inform residents of the community's plans for emergencies

Procedures:

A. Read and discuss "Planning for Emergencies." (Obtain from the county Civil Defense Office.)

B. Consider the following questions based upon what is learned from the reading:

- How would we know there is an emergency?
- What would we be asked to do?
- What specific plans have been made for children in school, people in institutions or other special facilities, and people with disabilities?
- What should we know about hazardous materials accidents and weather emergencies?
- What should we know about radiation?

C. Determine how well prepared your community is for an emergency.

- Use the local map in the Planning Guide and indicate the location of your home and school.
- What would be your evacuation route if you were at home? Are there alternate routes?

ISSUE 4

CONSUMERISM

Issue Four

CONSUMERISM

A. BACKGROUND

Every person who uses goods or services of any kind is a consumer. Most people become producers as well. A wise consumer develops an awareness of consumer pitfalls by continually analyzing data and making wise decisions which affect the use of money.

Teenagers constitute only 18 percent of the population yet they account for 40 percent of record sales, 55 percent of movie sales, and more than 35 percent of all cosmetic sales. This tremendous buying power/impact suggests both advantages and responsibilities. The market both curries favor with teenagers and at the same time attempts to exploit them. Teenagers must therefore use good judgment as they develop lifelong spending habits.

Consumerism, that is, promoting the interests of consumers, is an issue dealing with making wise choices. Within this unit the students will apply the science process skills to problem-solving, which aids in making these decisions. In order that students come away from this unit with usable information and knowledge:

- the activities should be organized to stress the impact of consumerism on a personal level and the effect of these decisions locally, nationally, and worldwide.
- the experiences should include relevant product testing using process skills.
- the students themselves should help to determine the nature of further activity and exploration.
- discussions should take place to reinforce the relevance of the newly-gained skills and information to the students' lives.
- new information should be applied to events occurring locally (the teachable moment).

B. ISSUE OUTLINE

Content Outline	Key Questions	Performance Objectives
I. The Nature of the Consumer		Students will be able to:
A. Consumers and producers complement each other in the natural environment. Producers manufacture food by photosynthesis and consumers eat the producers and/or eat other animals.	How do consumers and producers differ in the natural environment? What is the relationship between producers and consumers in the natural environment? **(Activity 4.1)**	• identify consumers and producers in the natural environment • state the relationship that exists between consumers and producers
	What are food chains, webs, and pyramids? Develop a food web using grocery store products that have been taken from producers and consumers in the natural environment.	• using grocery store products, construct food chains, webs, and pyramids to describe the relationship between producers and consumers
B. Consumers and Producers in Society – In our society, the actions of consumers directly affect the producers' productivity. In addition, the producers are also consumers.	Is there a distinction between producers and consumers in society similar to that in the natural environment? How do our buying patterns affect the economy? The buying habits of teenagers?	• describe the producer and consumer roles in our society • briefly describe how national spending trends affect the economy

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
1. effect on economy		• identify buying trends among teens. (Compare these to the buying power and trends of their parents as teens.
2. effects on energy use	Do you recognize the hidden energy costs associated with the production and use of different kinds of grocery store products?	• compare farmers' market items with supermarket items (produce) in terms of hidden energy costs associated with packaging, transportation, and storage.
3. consumerism	What is consumerism? What are the issues involved?	• develop a working definition of consumerism.
II. Sources of Information for Consumers		
A. Using available information – In order to make astute consumer decisions, individuals must use a wide variety of resources and information.		
1. determination of preference by personal experimentation	How do we determine our own personal preferences for products? **(Activity 4.2)** How "scientific" is our approach to personal products testing? Discuss some of the evidence you have that corporate advertising practices are not in the best interests of the consumer. (Use the Carl Rowan "Viewpoint" article found in **Appendix C** for discussion.)	• give personal examples describing how individuals decide which products to purchase. • relate personal preference experimentation to the problem-solving model to determine if any steps in the model were omitted.
2. comparing prices	What is unit pricing? How can unit pricing be used to compare products?	• define unit pricing • find unit pricing information in food store • use unit pricing to determine the best value
3. reading labels	What data can be gathered by studying labels?	• describe what information is common on similar product labels • interpret labels on various products to determine usefulness of labeling
4. observing warnings	Of what use are warning labels? Why are warnings attached to some products?	• name the types of products which display warning labels • formulate hypotheses as to why certain products must have warning labels
5. reading Federal and commercial consumer publications	How credible are public and private sources of consumer information?	• list the names of available consumer materials from both sources. Compare their quality as information sources.

Content Outline	Key Questions	Performance Objectives
B. Using scientific principles – As with any problem, decisionmaking about consumer concerns is best served by using established problem-solving procedures.		
1. problem-solving procedures	What procedures are followed to conduct valid scientific product tests?	In the process of solving a problem, the student will (be able to):
• identify a specific question, concern, or validity check regarding a specific product • locate and use source materials which will aid in obtaining pertinent information • organize data obtained in researching the solution to the problem • use appropriate experimental procedures to test hypotheses • analyze the problem to gain a better understanding of the problem • develop and use experimental procedures appropriate to the problem		• interpret organized data to identify relationships between important ideas • determine adequacy of procedure in application of hypothesis to problem • recognize variables pertinent to the solution of the problem • provide for a control situation • make observations • formulate testable hypotheses • formulate a conclusion based on the tested hypothesis.
2. using problem-solving techniques to test consumer products	How can we design experiments to prove the effectiveness of various products? Can we use experimental procedures to validate claims made by advertisers? How can we determine for ourselves the reliability of surveys used in product endorsements?	• compare effectiveness of similar household products using the problem-solving technique described • test the effectiveness of a certain product which uses a specific claim in its advertising • conduct a survey and analyze the results to determine whether advertised survey results are comparable • discuss the parameters and pitfalls of proper survey techniques
C. Product safety – There are numerous procedures, laws, and government agencies which help consumers by determining product safety or by addressing product/advertising claims.		
1. testing procedures – drugs and pharmaceuticals	What procedures are used to test medicines and drugs for safety? Investigate the ethical questions of drug tests on animals, on prisoners, etc.	• determine drug-testing procedures used for pharmaceuticals. • describe "orphan drugs."
2. Food and Drug Administration (FDA)	What is the role of the FDA? When does the FDA issue consumer warnings?	• describe the role of the FDA in protecting consumers. • identify situations which will lead the FDA to issue a product warning.
3. truth in advertising	How can we be sure that advertising claims are not false?	• research and report on various truth in advertising laws.
4. food tests	When do food additives undergo test procedures for safety?	• identify food additives and describe their various uses. • describe events which lead to additives being deemed unsafe.

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
D. Product packaging and design – Consumer habits are often dictated by something as seemingly superficial and inconsequential as packaging and design.		
1. ergonomics	How are product design and packaging decisions made?	• identify various forms of "packaging" which may affect a consumer's decision to buy • determine the needs for various types of packaging
	What is ergonomics? **(biotechnology; the application of biological and engineering data to problems relating to the mutual adjustment of man and the machine)**	• define ergonomics
	How does ergonomics determine the packaging of a product?	
	What human factors tests can help make packaging and design decisions?	• identify "human factors" as they relate to product packaging and design • describe how human factors are taken into account before product design is determined • measure various "human factors" • use measurements to design a package or product • identify products which were designed to meet various human factors measures • identify some "failures" in packaging due to disregard for human factors
E. Other types of research – Consumer awareness is at an alltime high because of the information available in guides, through groups, and from government agencies.		
1. consumer guides	What consumer guides are available? Compare them.	• list consumer guides found in the library
	How can we tell that the data in the consumer guides is unbiased?	• determine factors which make some consumer guides preferable to others
2. consumer awareness groups	What local and federal consumer awareness groups are available to aid in consumer decisions?	• list local, state, and Federal consumer protection groups • determine the scope of power of one of the consumer groups

Content Outline	Key Questions	Performance Objectives
F. External forces influence our choices – In spite of our best efforts to make wise consumer decisions using a problem-solving approach, external forces such as advertising, impulse-buying, and budgetary constraints prevent us from carrying them out.		Students will be able to:
1. advertising	What forms of advertising are we most frequently subjected to? **(Activity 4.3)**	• observe and identify the varying forms of advertising in the local area • calculate the percentage of time per TV hour that is devoted to advertising
	What advertising techniques are used to effect change in consumer behavior?	• analyze advertisements to determine the "mind, medium, method, and message" • classify advertisements according to these criteria • infer from ads and their placement what their intended audience is
2. impulse buying	What is "impulse buying"? What causes us to buy on impulse? How can we identify unethical or deceptive advertising?	• determine the danger spots for making impulsive purchases • identify examples of would-be deceptive or unethical advertising • generate a definition of unethical and deceptive advertising from examples
3. budget constraints	How can we determine whether or not we can afford our consumer choices?	• prepare a balanced budget based on income and needs • determine the amount of "disposable income" in the budget
	What is the cost of credit?	• interview individuals from lending institutions about the cost of various forms of credit
III. Being Wise Consumers		
A. Rights and responsibilities of minors as consumers – There are some legal distinctions between the rights and responsibilities of minors and those of adult consumers.	What are the rights and responsibilities of minors as consumers?	• identify the rights and responsibilities of minors • interview individuals from the community to determine the limitations of minors
B. Consumer assistance – An infrastructure of consumer assistance exists to redress consumer grievances.	Where can the consumer turn when a product or service is unsatisfactory?	• investigate the procedures for getting assistance in dealing with unsatisfactory service or products
C. Dealing with money – Counselors can help consumers deal with budget constraints.	Where can the consumer go when he/she encounters a budget crisis?	• describe the role of a credit counselor
D. Warranties and guarantees – The free-market economy has evolved rather extensive guarantees of product quality for the consumer's protection.	How can a knowledge of guarantees and warranties protect the consumer?	• describe the protection afforded by various warrantees and guarantees

C. ACTIVITIES

4.1. PRODUCERS AND CONSUMERS

Objective: To understand the roles of consumers and producers in the environment and in society

Procedures:

A. During a walking field trip of the immediate school neighborhood, identify parts of the ecosystem and relate them to consumers and producers. Point out the role of the decomposers.

- Design and draw food chains, webs, and pyramids. (Provide students with a film and/or readings about ecosystems.)

B. Discuss your role as a consumer and how your actions affect the economy of the local area, the environment, and the nation. (Invite speakers to discuss consumers and the economy. Also, provide the class with the reading, "Consumerism," below.)
List your purchases (and those of your family) during the course of a week.

- What items are common to virtually all class members?
- How do your choices compare to those in surveys showing national, teen spendings trends? (Refer to magazine reports such as those in US News . . . , Senior Scholastic, etc.)

Develop a definition of consumerism.

Consumerism

"A fool and his money are soon parted." It certainly seems that way. Separating people from their capital has long been a great challenge to unscrupulous individuals throughout recorded history.

Are you a consumer? Sure you are. Every person who uses goods or services of any kind is a consumer. As long as we live, we will be consumers, even though most of us become producers as well.

"Like to double your money?" "Buy now or lose the chance!" "Yours absolutely free!" "Sign here, it won't cost you a cent." "A once-in-a-lifetime opportunity." These are a few of the familiar come-ons used by clever promoters to "relieve" consumers of hundreds of millions of dollars annually. Those who can least afford the loss are often the victims.

How can you protect yourself against pressure tactics and shoddy merchandise? A wise consumer develops an awareness of consumer pitfalls and consistently applies the principles of consumerism.

You, as a young adult, belong to a powerful and important group of consumers. The more than 40 million of you between the ages of 13 and 19 spend over 26 billion dollars each year. It is no wonder that industrial and retail sellers pay very close attention to the youth market. You are an important part of the economy.

Teenagers as a group make up only 18 percent of the population. Yet, teenagers account for 40% of record sales, 55% of movie ticket sales and more than 40% of camera sales. You buy 40% of all sporting goods and 35% of all cosmetics.

This tremendous buying power provides you with added advantages and special responsibilities. You have an advantage in that you greatly influence what becomes available as consumer products. You also, however, have a responsibility to be a wise consumer. The spending habits that you develop now are those that will probably stay with you the rest of your life.

4.2. EXAMINING CONSUMER CHOICES

Objective: To learn to use scientific principles and problem-solving procedures to evaluate the products available to consumers

Procedures:

A. Find out what unit pricing means. Start by looking at unit price information on grocery store shelves and try to develop a definition by analyzing the purpose of these shelf labels.

- Why is unit pricing important to you as a consumer?

Collect labels from many different products, both grocery items and hand goods. Classify the labels by type: food, clothing, cleaning products, etc.

- Determine what information is common to all labels and what is specific to the type of product labeled.

Gather warning labels from various products. Discuss why warning labels are affixed to some products.

- How effective do you think these warning labels are?

Discuss the methods of personal experimentation we use to determine our preferences for certain products over others.

B. Refer to the problem-solving model provided in **II.B.** of the Issue Outline. Using the general outline of the model, conduct the following tests of various consumer products:

- Evaluate various antacid products to determine how much acid will be neutralized by each. Relate to the process of digestion.

- Determine the amount of "filler" in various brands of aspirin tablets. Sodium hydroxide (base) reacts with aspirin (acid). Use phenolphthalein as an indicator (increased amount of sodium hydroxide indicates more aspirin).
- Test fruits and vegetables for amount of Vitamin C. Mix iodine with juices; use small amount of starch as indicator. Iodine will not react with starch until the Vitamin C is used up. Increased amount of iodine solution added indicates increased amount of Vitamin C (titration).
- Test various brands of toothpaste for coarseness, bleaching action, moistness, irritation level, pH, and unit price.
- Test fabrics for durability, colorfastness, etc. during repeated washings.
- Test an assortment of detergents or bleaching agents on various types of stains, and fabrics.
- Test paper towels for strength and absorbency.
- Devise experimental procedures to test claims made by manufacturers; e.g., "no diet aftertaste," 'the sweetener that tastes like sugar'; "this paper towel is the quicker picker-upper," etc.

Conduct a survey to validate a claim made by a manufacturer

- Can these responses, thus the survey itself, be biased? Explain.

Analyze advertisements which contain survey results.

C. Obtain information on prescription drug testing techniques. Learn about the role of the Food and Drug Administration in this process. Identify products which have either been prevented from reaching the marketplace, withdrawn from the market, or have received consumer warnings from the FDA.

- Why were these actions taken?
- Discuss the topic of food additives.

D. Discuss what is meant by "packaging," including styles, shapes, and actual packages.

- Identify products which are advertised primarily on the merits of their packages rather on the product itself.
- Research the field of ergonomics and discuss the importance of having ergonomists as part of a production operation.
- List some human factors which have to be considered for the design of certain products (e.g., finger length and the distance to the shutter button on a camera).
- Determine which human factors had to be considered when designing a common object; e.g., desk chairs. Discuss these factors as they relate to the disabled consumer.
- Design a product package using human factors measurements taken in class.
- Identify products and fashions which have not succeeded because of the lack of consideration of human factors.
- Why do "faddist" consumers often ignore good (ergonomic) design when making purchases?

E. Name the various consumer guides that are available from libraries or at the newsstand.

- How do producers of consumer guides test products and make comparisons?
- After you have examined numerous guides, list the criteria necessary for an effective guide.

Use (a) consumer guide(s) to make a decision about a potential purchase.
Identify local, state, and national consumer groups. (Invite a member of a local group to speak to the class.)

- What influence does a consumer group have upon prices, trends, and buying habits?

4.3. THE POWER OF ADVERTISING

Objective: To learn about the subtle and not so subtle forces at work on consumers through advertising.

Procedures:

A. Record data about advertising to which you are exposed (TV, radio, news media, billboards, etc.)

- Tally the average number of commercials per hour of television; time the commercials and determine the percentage of each hour devoted to advertising.
- Analyze an advertisement to determine its "mind" – the intended audience; "medium" – what form does the ad take?; "method" – scientific claims, sex appeal, product-oriented, package-oriented, and "message" – what the ad wants you to do (buy, not smoke, etc.)
- Choose advertisements which demonstrate their appeal to particular audiences; relate the product and the audience to the placement of the ad (e.g., toy and cereal ads during children's cartoon time; beer ads during football games).
- Discuss what is meant by impulse buying.
- Analyze the placement of impulse items in stores, (near checkouts, special displays).
- Collect advertisements which are purposely deceptive. What makes the ad deceptive?

B. Simulate the experience of managing a household on a budget that is determined by an income you can reasonably expect to achieve sometime in the near future.

- Interview a head of household about the costs of running a household.
- Discuss whether all of your individual needs are covered in your budget.
- Determine whether or not any disposable income remains.
- Compare budgets with other members of the class in relation to needs and expectations.
- Interview individuals from various credit institutions regarding the cost of credit (banks, credit unions, financial services).
- How do you think what you have learned about consumerism will help you develop and maintain a satisfactory budget?
- What is the relationship between good consumer practices and disposable income?

ISSUE 5

FOOD AND NUTRITION

Issue Five

FOOD AND NUTRITION

A. BACKGROUND

Food is a basic, but limited, human resource and, as such, it epitomizes the interrelationships of human beings with their natural and social environments. The study of food links the natural and social sciences and provides a bridge from the personal to the community and, ultimately, to the global level. The biological production of food, augmented by agricultural and food processing technology, links science, technology and society. Human nutrition is so complex that it can be studied only by involving a large number of scientific and social scientific disciplines. The study of food and nutrition is, therefore, an ideal unit for a unified science program.

These same characteristics, however, present a problem for the teacher who wants to teach a 6-10 week unit on "Food and Nutrition": the subject is so broad that it cannot be covered within that time frame. Decisions must be made about areas of emphasis and how deeply to delve into the various aspects of food and nutrition. Rather than making such decisions for the teacher, and, thereby, limiting the subject, the suggested outline that follows is broad and inclusive. Each teacher is encouraged to adapt the outline to the interests and needs of his/her students and community.

The curriculum that finally develops at the local level should, however, have the following goals:

(1) to move students through developmental stages of awareness, knowledge, understanding, application, and action,

(2) to help students proceed from a personal level of awareness to a community and then to a global level, and

(3) to enable students to understand the intricate and intimate relationship between themselves as human beings and their physical, biological, and social environments.

Food has always had a primary place in the lives of people, but new awareness about the role of nutrition in physical and mental health, including cognitive development, points to a need for more nutrition education. Helping students to make informed decisions about diet, eating habits and consumer practices for themselves and their future families is one goal of this topic. Food is also a powerful social force and plays a major role in the health of a nation or society, as well as for the individual and the family. Food and nutrition, are, thus, matters of public concern. Another goal of this topic is to enable future citizens to contribute intelligently to public debate on food-related issues and to take responsible actions to improve the public health. Providing enough food for a growing world population is a global issue of major proportions. The demand for food has outstripped production in many countries, seriously affecting natural resources, and the economic and political realities of food distribution make it difficult to use food surpluses from other countries to solve the problems of starving nations. A fourth goal for this topic is to help students understand nutrition problems of people in other areas of the world and the social, economic, and political implications of the world food problem.

B. ISSUE OUTLINE

Content Outline	Key Questions	Performance Objectives
I. The Nature of Food	**(Activity 5.1)**	Students will be able to:
A. The functions of food – Foods contain six basic nutrients that provide energy and/or chemicals needed by the body to build and repair tissue or regulate body processes.	Why do we need food?	• compare the food energy and material requirement of four major life functions.

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
B. The nutrients in food – Each nutrient has specific uses in the body.	What substances are in the food we eat?	• list the major classes of nutrients, describe their functions and identify foods which are good sources of these nutrients.
C. Digestion and absorption of food – The process of digestion changes foods into simpler components that the body can absorb and use.	How do the foods we eat become converted into energy and living material?	• explain that nutrients must be broken down mechanically and chemically, absorbed into the body, and transported to the cells.
D. Nutritional requirements – The required nutrients are carbohydrates, fats and oils, proteins, vitamins, minerals, and water.	What determines an individual's nutritional requirements? How much and what type of nutrients are suggested for good health?	• explain that nutritional requirements vary but that certain guidelines have been developed for calorie, protein, fat, vitamin, and mineral needs.
E. Health and food habits – A balanced diet consists of a selection of foods that provide an adequate supply of energy and chemicals.	What is the relationship between diet and health? **(Activity 5.2)** What food habits promote good health?	• select a healthy, balanced diet and list good food habits.
F. Effects of dietary deficiencies/surpluses-Major deficiencies and/or surpluses in the diet cause discomfort, poor health and pave the way to disease and death.	What effects do dietary deficiencies or surpluses have on health?	• describe the effects of diets that are deficient in, or have a surplus of, certain nutrients.
II. Food Production		
A. Ecology and food production – Ecology is the study of the organisms with their living and non-living environments. Food production is the primary interaction.	How is food produced in natural ecosystems?	• describe the role of energy, nutrients, and producers and consumers in ecosystems. • understand that ecosystems require a constant input of energy and recycling of matter.
B. Hunting/gathering to agribusiness - Humans have progressed from the simplest of consumers to masters of complex systems of food production.	How have humans made use of natural food production to increase food supply?	• describe the stages of development of agriculture, including hunting/gathering, cultivating grain, irrigating, using animal power, fertilizing crops, and selective breeding.
	How has modern technology affected agriculture?	• describe modern agricultural methods and their advantages and disadvantages.
	How is food processed from farm to table?	• state that food production has many stages, uses technology, and affects the nutrient value of food.
C. Energy/Environmental Costs of food production and distribution – Only constant attention to conservation and preservation will mitigate the considerable energy/environmental costs of modern agriculture.	What are the energy costs and environmental impacts associated with the processing of food from farm to table?	• compare the energy and environmental costs of three distinctly different food/agricultural systems (slash and burn, Asian rice culture, American corn production).

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
D. Future sources of food – Rapidly increasing world population makes it imperative that we continually search for new sources of food. What are the energy costs and environmental impacts associated with the processing of food from farm to table?	What new sources of food are being explored for the future benefit of humans?	• list some sources of food that are being explored in order to increase food supply in the future.
III. Food and Society		
A. Society technology, and food – The food choices of people are greatly influenced by social and technological factors.	How do social, economic, and cultural factors affect food choice? How do society, technology, and food supply interact in the modern world? How much energy is required to produce a usable gram of protein?	• understand that food choices are influenced by social, economic, and cultural factors. • understand that economic and social factors affect food choices and technology and that food affects the physical, economic, psychological and political health of society.
B. Economics of food – Economic circumstances affect food supply, distribution, diet, and the health of individuals.	How can individuals and families obtain maximum food value for their financial resources?	• analyze family food expenditures, especially with regard to non-nutritious foods; • recognize the role of advertising in shaping our food preferences; • adopt intelligent consumer practices.
	How do economic factors affect the production, supply, and distribution of food in the world?	• understand how economics affects the raising, marketing, and distribution of food around the world.
C. Government and food – Government intervenes in society's food chain through testing, regulations, and subsidies.	How does government regulate food production and quality?	• understand the basic ways in which government regulates agricultural production and affects the safety of food.
	What is the citizen's role in government regulation of food?	• learn some constructive ways in which citizens can affect government policies.
IV. World Food Supply	**(Activity 5.3)**	
A. World population and food supply - World population growth has made food supply one of the most pressing problems of this century and the next.	How have population size and food supply increased through history? (See **Appendix C,** page 63, "The population Challenge," and page 66 "Enough food for Everyone.")	• describe and compare the growth of the world's human population and the increase in world food supply.
B. Food supply in developing and developed countries – Most developing nations import food, or should, to provide adequate diets for their populaces.	How do food problems in developing and developed countries differ?	• explain the difference between developed and developing countries. • compare population increase, food supply and diet in developing and developed countries. • list causes of the food crisis in the developing countries.

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
C. Overcoming limitations on food production -Technology will continue to play a major role in alleviating nutritional deficiencies throughout the world.	What are some of the limitations on increasing food production?	• describe factors limiting world food production. • explain the concept of carrying capacity.
	What are some ways to increase food production?	• describe some new methods being tried to increase food production and to develop new sources of food.
	What are some potential new sources of food?	• understand the problems of distribution of food and the use of food for economic and political leverage.
	What are some possible solutions to the world food problem?	• discuss the advantages and disadvantages of some proposed solutions to the world food problem.

C. *ACTIVITIES*

5.1. FOOD: WHAT'S IN IT?

Objective: To determine the main ingredients, the food group, and the additives in foods commonly eaten

Procedures:

A. Collect labels from 10 foods which you commonly eat. Fill in the Data Table on page 50 classifying the food according to the four basic food groups, and list the main ingredients (e.g., tomato soup: tomatoes, corn syrup, wheat flour, salt) each.

- If you ate portions of each of these in one day, would you be getting the correct amount of:
  - calories?
  - protein?
  - sodium (salt)?
  - vitamins?
- Contact the headquarters of "fast food" chains to learn the nutritional content of their menus.

(Refer students to the Food Additives table on p. 51)

- Which food contained additives?
- Which additive was most common?

B. Try to construct a balanced diet for one day using the 10 foods. If you cannot, trade labels with other students to create a balanced diet. If necessary, list the foods you would add to what you have to make a good diet. Compare this "trade" to international trade in food stuffs.

5.2. PERSONAL EATING HABITS

Objective: To analyze personal eating habits in an effort to work toward a good, healthful diet.

Procedures:

A. Record all you eat and drink in a 24-hour period on the blank Food Record provided on page 52.
Use the table of calories in **Appendix C** to determine the calories in each item you ate. Total the number of calories for each meal and for the entire day.
Calculate your calorie requirement and compare it with the number of calories you ate:

Boys (13-20 years):
28 x body weight (in pounds)
Girls (13-20 years):
24 x body weight (in pounds)

B. Use the table of usable proteins in food (p.53 to determine the number of usable grams of protein in each item you ate. Total the number of grams of usable protein for each meal and for the entire day.
Calculate your protein requirement and compare it with the number of grams of protein you ate:

grams usable protein needed = 0.28 x body weight (in pounds)

C. Check your food list against the table of Food Require-

ments on page 54. Record the vitamins and minerals you ate on the food record.
Make a list of the vitamins and minerals missing from your diet.

- How could the lack of these vitamins and minerals affect your health, growth, and learning?

Based on this study, list the changes, if any, you would make in your diet.

5.3. WORLD FOOD SUPPLY

Objective: To learn about the problems of food supply and nutrition which beset the less developed areas of the world

Procedures:

A. Read the article, "Enough Food for Everyone," which is provided on page 66 in **Appendix C,** and then develop the following:

- a statement of the problem described in the article
- a list of significant information in the article related to the problem
- a list of the key causes of the problem
- a list of some possible solutions to the problem.

B. Study the graph on page 55 and answer the following questions.

- How does the per capita level of calories per day in Pakistan and Bangladesh compare to that in North America? to average daily requirements?
- Which areas(s) of the world have the highest per capita protein intake? the lowest? How do these values compare to the average daily requirements?
- Does the information in the graph support or contradict that in the article? Explain.
- In your own words, explain your views on the world food problem and the possible solutions.
- How can we prevent malnutrition in our own country's communities?

DATA TABLE – FOOD ADDITIVES

Name of Food/ Food Group	Main Ingredients	Calories/ Serving	Amount of: Fat	Carbo.	Protein	Sodium/ Serving	Additives/ Class

FOOD ADDITIVES*

Class	Purpose	Examples
Flavorings	To provide attractive flavors.	*natural, safe:* citrus oils, amylacetate, cloves, cinnamon
		natural, unsafe: nutmeg, safrole
		synthetic: vanillin, limonene, 1-malic acid
Colors	To improve the appearance.	*natural:* chlorophyll, beta-carotene, annatto, caramel, cochineal
Preservatives	To prevent spoilage and increase shelf life.	*antioxidants:* BHT, BHA, ascorbic acid (vitamin C), alpha tocopherol (vitamin E), propyl gallate, lechithin, citric acid, stearyl citrate, isopropyl citrate, stannous chloride
		antimicrobials: sugar, salt, vinegar, calcium, sodium propionate, sodium benzoate, benzoic acid, sorbic acid, calcium, potassium and sodium sorbate, sulfur dioxide, sodium bisulfite, methyl paraben, sodium nitrate, sodium nitrite
Texture Agents	To improve the texture of food.	*emulsifiers:* phosphoric acid, phosphates, polysorbate 60, 65, and 80; sorbitan monostearate, lechithin
		stabilizers/thickeners: agar, alginates, carrageenan, gelatin, sorbitol, pectin, gums, sodium carboxymethylcellulose, starch
Acid Controllers	To maintain a desired acidity or alkalinity.	phosphoric acid, citric acid, lactic acid, acetic acid (vinegar)
Leavenings	To make dough rise.	baking soda (sodium bicarbonate), baking powder
Nutrients	To improve nutrient value of food or replace nutrients lost in food processing.	vitamins, minerals

* Brody, Jane E. Jane Brody's Nutrition Book. 1981. New York. W.W. Norton and Co.

FOOD RECORD

Breakfast			Lunch			Snacks			Dinner		
Food	Cal.	Prot. gms.	Food	Cal.	Prot. gms.	Food	Cal.	Prot. gms.	Food	Cal.	Prot. gms.

Total number of calories in a day = breakfast + lunch + snacks + dinner = _____

Calorie requirement, based on formula = _____

Total number of grams of usable protein in a day = breakfast + lunch + snacks + dinner = _____

Protein requirement, based on formula = _____

carbohydrates	*fats and oils*	*proteins*	*minerals*
1.	1.	1.	1.
2.	2.	2.	2.
3.	3.	3.	3.
4.	4.	4.	4.
5.	5.	5.	5.
6.	6.	6.	6.
7.	7.	7.	7.
8.	8.	8.	8.
9.	9.	9.	9.
10.	10.	10.	10.

Vitamin	in diet		Sources of Vitamin
	yes	no	
A			
B			
C			
D			
E			
K			

GRAMS OF USABLE PROTEIN IN COMMON FOODS

Meat and Poultry

roast turkey, 3 slices – 22
pork chop – 19
porterhouse steak, 1/2 lb. – 17
hamburger, 1/2 lb. raw – 17
chicken breast – 15
lamb chop – 13

Vegetables – 3 1/2 oz. raw

lima beans, green – 4
peas, 3/4 c. – 3
brussels sprouts, 9 – 3
corn, 1 ear – 3
broccoli, 1 stalk – 2-3
asparagus, 5-6 – 1.8
artichoke, 1/2 large – 1.8
cauliflower, 1 c. – 1.8
spinach 1/2 c. cooked – 1.5
potato, 1/2 medium – 1.2
swiss chard, 3/5 c. cooked – 1

Flour – 1 cup

soybean – 40
whole wheat – 10
white flour – 8
cornmeal – 5

Grains, cereals, etc.

egg noodles, 1 c. cooked – 4
cracked wheat 1/3 c. – 4
barley, 1/3 c. – 4
spaghetti, 1 c. cooked – 3
macaroni, 1 c. cooked – 3
oatmeal, 1/3 c. – 3
rice, brown, 1/3 c – 3
rice, converted, 1/3 c. – 3
rice, white, 1/3 c. – 2
bread, 1 slice, whole-wheat – 1.2

Nuts and seeds

peanuts, 2 tbsp. – 3
peanut butter, 2 tbsp. – 3
sunflower seeds, 3 tbsp. – 4
cashews, 12-16 – 3
walnuts, 16-20 halves – 3
pumpkin seeds, 2 tbsp. – 5

Dried Beans – 1/4 – 1/3 c. dry

soybeans – 10
peas – 6
black beans – 5
kidney beans – 5
chickpeas – 5
lima beans – 5
lentils – 4
others (navy, pea, white) – 4
beans

Dairy Products

cottage cheese, 6 tbsp. – 12
milk, 1 c. – 7
yogurt, 1 c. – 7
swiss cheese, 1 oz. – 6
egg, 1 medium – 6
ricotta, 1/4 c. – 5
cheddar cheese, 1 oz. – 5
ice cream, 1/5 pint – 4

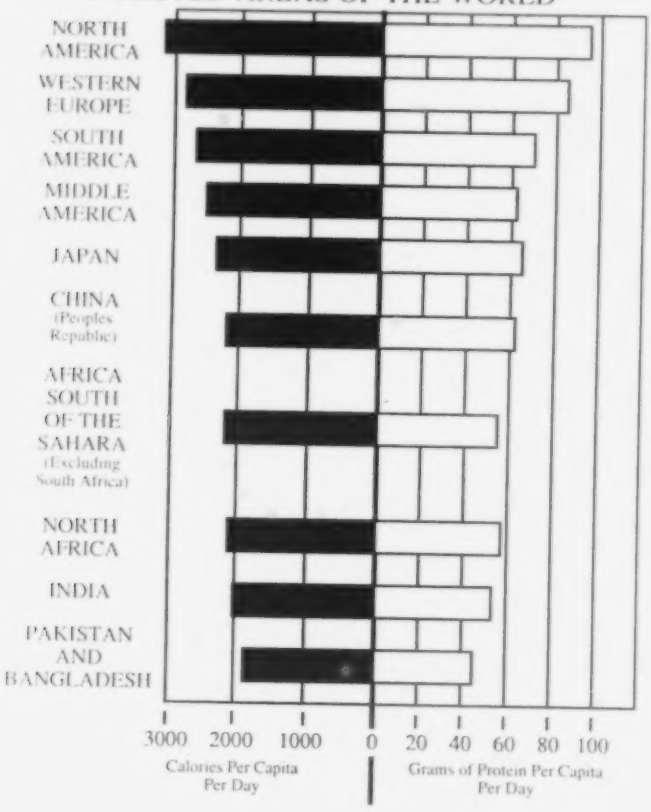
Seafood – 3 1/2 oz.

tuna, in oil, drained, 5/8 c. – 19
halibut – 17
salmon – 16
bass – 15
shrimp – 15
sardines, 8, in oil – 14
cod – 14
haddock – 14
crab – 14
squid – 13
scallops, 2-3 – 12
flounder – 12
clams, 4 large or 9 small – 11
oysters, 2-4 – 9

FOOD REQUIREMENTS

Nutrient	Uses	Sources
carbohydrates (sugars and starches)	source of energy	cereals, potatoes, bread, fruit, candy
proteins	needed for their amino acids which are used to build the structures of the body and enzymes; needed for all body activities	meat, fish, milk, eggs, cheese, beans, peas, nuts
fats and oils	source of energy and also used to build many important structures in body	butter, cream, lard, fats in meat, vegetable oils, nuts
water	needed for all chemical activities of the body and to transport materials in body	beverages and most foods
calcium and phosphorus	build strong bones and teeth	milk, cheese, eggs
iodine	needed to make hormone which controls rate of metabolism	sea foods, iodized salt
fluorine	prevents tooth decay	in some water and also in fluoridated water and toothpaste
sodium	needed for proper functioning of cells	table salt and in many foods
chlorine	needed to make hydrochloric acid to digest food in stomach	table salt and in some foods
vitamin A	necessary for vision	yellow and green vegetables and animal food
vitamin B (a group of 11)	required for the proper functioning of enzymes	animal meats, whole-grain cereals, and some other vegetables
vitamin C	prevents scurvy	citrus fruits, some fresh vegetables
vitamin D	helps calcium and phosphorus build strong bones and teeth	added to milk, saltwater fish, egg yolks
vitamin K	necessary in blood-clotting	widely distributed

CALORIE AND PROTEIN SUPPLY, SELECTED AREAS OF THE WORLD



ISSUE 6

SCIENCE, TECHNOLOGY, AND AUTO SAFETY

Issue Six

SCIENCE, TECHNOLOGY, AND AUTO SAFETY

A. BACKGROUND

Given the technological advances our society has made, it is one of our great frustrations that so many tragedies continue to occur on our nation's highways. What are the reasons for the seemingly unavoidable injuries, and losses of life and property?

Is unsafe speed still a major factor? There has been some reduction in the death toll attributed to the 55 mile per hour speed limit, but there are still nearly 50,000 lives lost each year in automobile accidents. If reduced speeds help save lives, are we doing enough to enforce lower speed limits?

How have cars changed over the years? Are they safer now? Is the construction of autos better than ever? Do seat belts and other restraint devices accomplish what is intended?

B. ISSUE OUTLINE

Content Outline	Key Questions	Performance Objectives
		Students will be able to:
I. Restraint Systems The Federal Government requires that restraint systems be installed in new autos as a means of minimizing personal injuries during automobile accidents.	Are seat belts, air bags, and padded dashboards worth the investment? Why or why not? **(Activity 6.1)**	• compare the different types of restraint systems in terms of cost, effectiveness, convenience and style.
II. Speed Limits Speed limits are proposed after consideration is given to factors such as population density in the area, composition of the road, curves, and prevailing weather.	Do speed limits contribute to safer travel? Explain. **(Activity 6.2)**	• judge how safe posted speed limits are in a particular locality; and, in instances where limits seem unsafe, make specific recommendations for improving the highway or changing the speed limit.
III. Car Body Construction Design and styling of the auto has changed considerably since Ford's Model T, with new materials, improved engines, and many new design features.	Are cars constructed for beauty or safety, or for both? Explain. **(Activity 6.3)**	• act as responsible consumers by evaluating changes in auto design and style on the basis of safety, cost, durability and aesthetic appeal.
IV. Different Generations of Autos Throughout the 80-plus years of the auto industry, distinctly different styles of autos have been designed to serve lifestyles and needs of the times.	How have cars changed? How did these changes reflect the times during which they occurred? **(Activity 6.4)**	• relate the characteristics of autos through the years to the times in which they were produced.

C. ACTIVITIES

6.1. Have students observe and discuss the physical principles involved with collisions; e.g., seatbelt science and packaging passengers.

Students should investigate the increasing trend in head injuries and their effects on families and the community. Information is available from the New York State Head Injury Association, Inc., 194 Washington Avenue, Albany, NY 12210.

Have students observe different road surfaces and discuss how their physical properties contribute to or detract from auto stability at various speeds.

6.2. Locate curved road areas with their posted speed limits and discuss how cars are affected when they go into a curve.

6.3. Compare the frames and supporting structures for several makes and models of autos.

- Which models appear to be safer? Why?

Note: Guest speakers from highway police transportation departments, consumer groups, and the insurance industry should be used.

6.4. Compare autos from the early sixties and seventies with new cars and describe major discrepancies with respect to style, weight, size, types of tires, bumpers, headlights, mirrors, required lights, etc. Categorize major changes such as safety features, increasing cost effectiveness, or style changes.

Note: Older cars can often be located within the community and details concerning their features can be obtained from old car manuals or consumer reports.

APPENDICES

A. Additional Issues
B. Activity References
C. General References
D. Sample Evaluation Items
E. Reading and Writing in Science
F. Goals of the Board of Regents
G. NSTA Position Statement
H. Guidelines for the Use of Vertebrate Animals
I. Students with Handicapping Conditions

Appendix A – Additional Issues

The issues listed below are provided as ideas for the development of alternative units in unified science. One or more may be used as substitutes for the six issues which are the focus of this publication.

1. **Space Travel** – What are our objectives in space?
2. **Nuclear Energy** – Is nuclear energy a threat, a boon, or both?
3. **Alternative Forms of Energy** – What are our choices?
4. **Substance Abuse** – It affects our bodies and it affects society. What can we do about it?
5. **Water Conservation** – How can there be a local, national, or global water shortage when the amount of water on our planet has remained relatively constant?
6. **World Food Supply** – Why is food being stored while people are starving?
7. **Land Use** – What are we not doing right?
8. **Solid Waste Management** – The throw-away society is learning there is no "away." How do we replace the sanitary landfill?
9. **Genetic Engineering** – Is its potential both harmful and beneficial?
10. **Chemistry and Physics at Home** – How are the principles of these disciplines applied daily in your home?

Other topics to consider:

11. **Diseases**
12. **Stress and Health**
13. **Agriculture/Agribusiness**
14. **Parenting – What are the responsibilities?**
15. **Mass Transportation**
16. **Technology and Medicine**
17. **Noise Pollution**

Appendix B – Activity References

1. Environmental Decisions

Air Module, Modular-Science/Technology/Society, P.O. Box 1603, Wausau, Wisconsin, 54401.

An Environmental Syllabus, New York State Education Department, Albany, New York 12234.

It Stacks Up, Division of Environmental Education and Division of Air, New York State Department of Environmental Conservation, 50 Wolf Road, Albany, NY 12333 (518-457-3720 and 4577230).

Miller, G. Tyler, *Living in the Environment*, 1979, pages 260-261, 265-273.

"Noise Pollution: Irritant or Hazard?," *Harvard Medical School Health Letter*, June, 1986.

Water Module, Modular-Science/Technology/Society, P.O. Box 1603, Wausau, Wisconsin, 54401.

2. Science and Crime

Criminalistics: An Introduction to Forensic Science (2nd ed.), Saferstein, Richard, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1981.

Police Science Teacher's Manual, McDonald, Phyllis Parshall, (ed.), Kensington, Maryland: Kemtec Educational Corporation, 1979.

Science Against Crime, Deutch, Yvonne, (ed.), New York, New York: Exter Books, 1982.

Unified Science Syllabus, Unified Science Education Program, Rochester City Schools, 131 West Broad Street, Rochester, NY 14608 (716-381-9940)

3. Disasters

Oberkrieser, Joseph, *Concepts in Modern Chemistry*, New York, New York: Globe Book Co., Cambridge Division, 1982.

"Emergency Management, U.S.A.," (FEMA Self-Directed Study Program, Lansing, MI 48901) 1981.

"Planning for Emergencies," New York State Disaster Preparedness Commission, (your county Civil Defense Office) 1985.

"Radon: Deadly Gas Threatens Millions," *Current Science*, Jan. 2, 1987.

"Radon Exclusive," V. Elaine Smay, *Popular Science*, November 1985, pp. 76-79, 101.

"Superquake: When Will It Strike," *Current Science*, Oct. 31, 1986.

"Your Chance to Live," Far West Laboratory for Educational Research and Development (Defense Civil Preparedness Agency, Baltimore, MD 21220), 1972.

4. Consumerism

"Advertising," *Prism Curriculum*, Rochester City Schools, 131 West Broad Street, Rochester, NY 14608.

"Buying and Selling," *ISIS*, Ginn and Company,

"Consumerism," *Unified Science Syllabus*, Unified Science Education Program, Rochester City Schools, 131 West Broad Street, Rochester, NY 14608.

5. Food and Nutrition

Barman, Charles R. "Nutrition Education: An Essential Ingredient of Biology Education." *The American Biology Teacher*, 47(6): 333-339, 1985.

Christensen, John W. *Global Science: Energy, Resources, Environment*, Dubuque, Iowa: Kerdall/Hunt Publishing Co., 1984.

Ciekot, Jerald. "Hunger on Spaceship Earth: Simulation Game." Available from the New York Metropolitan Regional Office of the American Friends Service Committee, 15 Rutherford Place, New York, NY 10003.

Ciekot, Jerald J. and Douglas Gwyn. *Ending Hunger: It's Possible, It's Happening*. 1979. Available from the World Hunger/Global Development Project, American Friends Service Committee, 15 Rutherford Place, New York, NY 10003.

"The Craze for Calcium," *Newsweek on Health*, Summer, 1986.

"Fast Food: Part of a Nutritious Diet," *Science of Food and Agriculture*, November, 1986.

Food, vol. 1 (1975-1976; 100 articles); vol. 2 (1977-1981; 100 articles); vol. 3 (1982-1985; 80 articles). Social Issues Resources Series, Inc., P.O. Box 2348, Boca Raton, Florida 33427.

Froyen, Curt. "A Simple Equation – More People = More Food. The Search for Solutions" (Teaching Notes #12). Philips Petroleum Public Affairs, 16 B4 Philips Building, Bartlesville, OK 74004, 1986.

Lifetime Learning Systems, Inc. *Health and Nutrition: The Public and Private Records*. National Livestock and Meat Board, Education Department, 444 N. Michigan Avenue, Chicago, IL 60611. ($2.95 per kit) 1986.

Richardson, Lucy, Jerald Ciekot, and Judith Sherk. *Women in a Hungry World: A Study/Action Kit*. World Hunger/Global Development Project, American Friends Service Committee, 15 Rutherford Place, New York, NY 10003, 1979.

"Salt in Cereal," *Current Science*, Nov. 14, 1986.

"These People Cannot Wait." World Hunger/Global Development Program, American Friends Service Committee, New York Metropolitan Region, 15 Rutherford Place, New York, NY 10003 (also available *Hunger in Africa: the AFSC Responds*, a slide show for rental [fee $15] and *World Hunger Actionletter*, bimonthly [free])

6. Science Technology and Auto Safety

Packaging Passengers, Individualized Science Instructional System, Lexington, MA: Ginn and Company, 1976.

Seat Belt Science: Activities for General Science, National Highway Traffic Safety Administration, Washington, DC: U.S. Department of Transportation, 1982.

Appendix C – General References

1. See ISSUE 1, page 13 and ISSUE 5, p.47.

"The Population Challenge." Zero Population Growth, Inc. 1986 (Washington, DC) (Excerpted with permission.)

Asia, Africa, Latin America: These are the places Americans usually associate with population crises. By what twist of the imagination is the United States on such a list? It boasts the highest standard of living in the world. Its farms produce more food than Americans need or even sell. Western states like Wyoming and Nebraska have unsettled grasslands that stretch as far as the eye can see.

But appearances are deceiving. Many sparsely populated areas in America cannot support large numbers of people. The country's high-tech farms require only two percent of the population to run them. And so Americans congregate in cities and expanding suburbs.

The impact of 5 or 10 million densely packed Americans on an urban region is incredible. Overcrowding in Los Angeles, for example, slows freeway traffic to 20 m.p.h. for 14 hours of every day. Cars, factories, and power plants pour tons of toxic pollutants into the air. Winds carry acid rain formed by these nitric and sulfuric wastes to neighboring states. The smog in Los Angeles and other big cities is an all-too familiar example of environmental harm resulting from overpopulation.

NEED FOR AWARENESS – THE ROLE OF ZPG

Measured by the length of human history, the population problem is recent. It took about three million years for the global community to reach one billion, the total in 1800. In just 130 years more, the number doubled. By 1960, it was three billion; by 1975, four billion; in 1987, five billion. It is projected that six billion humans will inhabit the Earth in the year 2000.

The most visible effects of this explosion have been in the poorest countries of the world. But by the 1960s, the special, two-fold impact of the U.S. population crisis was also clear. Not only are Americans – rapidly growing by two million every year – damaging their own environment. As the world's superconsumers, they drain precious resources from every other continent as well.

The situation is so serious that some Americans work fulltime at resolving it. In 1968, appalled by what they saw as the coming population explosion, Dr. Paul Ehrlich and other concerned citizens formed Zero Population Growth (ZPG), a national, nonprofit organization that works on two fronts: urging voluntary efforts to stabilize the U.S. population, and lobbying to protect the Earth's environment and resources.

Americans tend to think of a healthy economy in terms of a favorable balance of trade or high employment. But the basic building blocks of a nation's or region's economic health are four major biological systems: Earth's ocean fisheries, grasslands, forests, and croplands. These are fundamental lifesupport systems. In an overpopulated planet, the health of these systems is increasingly at risk.

EARTH'S LIFE-SUPPORT SYSTEMS

Fisheries. The oceans have always been a principal source of high-quality protein for humans. And the fish that humans don't eat, birds and other animals do. Since 1970, the annual catch per person has dropped 13%.

Grasslands. One fifth of the planet's land is grazed by billions of animals that, in turn, sustain billions of people through the meat, milk, cheese, leather, and fur they supply. As swelling populations expand their livestock herds, huge grasslands are being grazed to dust.

Forests. Wood is a primary building material all over the world and is the principal energy fuel in many developing countries. Since 1974, the world's forests have been cut faster than they can replace themselves.

Croplands. Topsoils are the source of the greatest variety of products, including foods and industrial raw materials: rubber, fibers, alcohols, and vegetable oils. Both subsistence farming and the cash crops of big business have destroyed millions of acres of croplands.

In many places Earth's life-support systems are breaking down with terrible human consequences. The tragic news of expanding deserts and deepening famine in Africa is familiar to every American. China, with a one-billion-plus population, instituted its strict "one-child family" policy after losing as many as 30 million people in a 1960s famine. An estimated 15,000 landless farmers in

Bangladesh recently lost their lives in a tidal wave after taking the desperate risk of settling on a low, silt-formed island in a cyclone belt.

How do such problems touch America? Is there anything beyond the impact of daily news reports that connects us to the environmental crises of other nations?

2. See ISSUE 1, p. 12.

Source: "It Stacks Up," New York State Environmental Conservation Department, Albany, NY, pp. 6-8, 1980.

PARTICULATE MATTER

Solid or liquid particles and droplets, including dust, smoke fumes, fly ash, mists, and sprays...

Sources: Industrial processes, incinerators, furnaces, and fossil fuel burning plants, especially those that burn coal; also automobile exhaust and road and building construction.

Health effects: disruption of the lung's normal cleansing mechanism. Additionally, the particles can contain or carry materials that exhibit direct toxic effects on a biological system.

Other effects: scattering and absorption of sunlight which results in haze, reduces visibility, and reduces solar energy reaching Earth; particles soil materials, are corrosive and can damage buildings.

NITROGEN DIOXIDE (NO_2)

A reddish-orange-brown gas with a characteristic pungent odor...

Sources: emitted in approximately equal quantities from motor vehicles and from fossil fuel burning operations, most notably power plants, also from chemical plants and refineries – the amount depending on temperature of combustion. Even a gas kitchen range can increase indoor levels of NO_2 if adequate ventilation doesn't exist.

Health effects: increased respiratory infections in children (particularly bronchitis); eye, nose, and throat irritation when combined with sunlight and hydrocarbons to form photochemical smog; inhibition of action of the cilia and damage to lung tissue. This substance has been known to produce emphysema-like changes in experimental animals.

Other effects: corrosion of metal surfaces, deterioration of rubber, fabrics and dyes; serious injury to vegetation, including bleaching or death of plant tissue, loss of leaves, and reduced growth; highly toxic to animals; instrumental component in smog formation reaction; acid rain, caused in part by chemical conversion of NO_2 to nitric acid.

PHOTOCHEMICAL OXIDANTS

Extremely reactive oxidizing agents formed primarily by reaction between oxides of nitrogen and hydrocarbons in sunlight (smog); includes ozone...

Sources: secondary reaction products originating largely from fossil fuel combustion byproducts.

Health effects: irritates eyes, lungs, nose, and throat; causes difficult breathing.

Other effects: toxic to plants, primarily affects leaves, and can weaken materials like rubber and fabrics.

SULFUR DIOXIDE (SO_2)

A heavy, pungent, colorless gas...

Sources: installations burning a fossil fuel. Electric power plants, home heating, and industrial processes provide the greatest sources of sulfur dioxide.

Health effects: impairment of breathing and irritation of eyes, throat, and lungs. Fortunately, breathing effects appear to be reversible when the insult is removed.

Other effects: corrosion and deterioration of iron, steel, copper, nickel, aluminum, and building materials; brittleness in paper; loss of strength of leather; deterioration of natural and synthetic fibers; corrosion of limestone and concrete structures; destruction of plant and tree foliage; acid rain, caused in part by chemical conversion of SO_2 to sulfuric acid.

CARBON MONOXIDE (CO)

A colorless, odorless gas...

Sources: internal combustion engines (95 percent from automobile exhaust); CO is a normal byproduct of incomplete combustion of fuels and organic wastes.

Health effects: Hemoglobin – the oxygen-transporting substance in the blood – combines 200 times more readily with carbon monoxide than with oxygen. This results in reduced circulating oxygen with subsequent oxygen deprivation to vital tissues of the body. The two tissues most sensitive to this, the heart and the brain, are most seriously affected.

Due to hemoglobin's affinity for carbon monoxide, even low levels cause dizziness, headache, fatigue, and slower reactions; dangerous to sufferers of heart disease, anemia, and circulatory ailments. At 1000 parts per million exposure, death results from paralyzed normal brain function.

HYDROCARBONS (HC)

Chemicals from combustion of organic compounds and other evaporated chemicals...

Sources: internal combustion engines, industrial processes, evaporation from paint and cleaning solvents, and fuel storage.

Health effects: no direct health effect alone; however, combines with nitrogen dioxide to form photochemical smog.

Other effects: certain specific hydrocarbons can produce cancer in animals and cause plant damage as a component of photochemical oxidants.

THE SOURCES OF AIR POLLUTION

Particulates	11.3	32	34	12	11 = 100%
Sulfur Oxides	2	62	6	30	0.3 = 100%
Nitrogen Oxides	32	34	2	32	0.6 = 100%
Hydrocarbons	58	8	28	2	5 = 100%
Carbon Monoxide	95	0.2	2	1	2 = 100%
	Motor Vehicles	Power Plants	Manufac-turing	Heating	Solid Waste

3. See ISSUE 4, page 37.

"The 'Gifts' of Drugs, Tobacco, Booze, and Beer," Carl Rowan, Cortland (NY) **Standard**. October 15, 1986, p.8.

WASHINGTON – You can determine the "underclass," the "victims of choice," of this and other societies by looking at who is trying to sell what to whom.

I shall never forget the Mafia don in "The Godfather" saying that his mobsters would make a mint selling drugs to black people.

They have. But the scourge of "crack," regular cocaine, marijuana and other illicit drugs long ago ceased to be a "black," or "minority" problem. Every precinct of America has now fallen victim to drug abuse. It is noteworthy that an article out of Bogota, Colombia, recently said: "With the United States now flooded with cocaine, South America's drug traffickers are targeting Western Europe as their next market."

But this is not another column about drug abuse. It is about the ways in which the same "underclass" becomes the prey of those selling legal poisons. It is about the well-known corporations that try to "make a mint" by pushing cigarettes, booze and beer within black America.

Cancer is the great American killer, and there is no longer reasonable doubt outside the tobacco industry that cigarette smoking causes lung cancer. Where is the beleaguered tobacco industry now putting on its great push to sell More, Salem, Kool, Newport, Virginia Slims and other cigarettes? Among blacks, that's where.

Wherever blacks are putting on a convention or any other affair of consequence, R.J. Reynolds, Philip Morris, Brown & Williamson and the other companies are there, or trying to be, pushing cigarettes that are "a major health hazard," according to Dr. LaSalle D. Leffall Jr., chief of surgery at the Howard University Hospital here and past president of the American Cancer Society. Whether it is a prestigious affair of the Congressional Black Caucus, a fashion show put on by Ebony magazine or a local Urban League banquet, the cigarette makers want to be there, demonstrating their "largess.'

Their "gifts" take a heavy toll. Leffall points out that the incidence of lung cancer among black males is 60 percent higher than among white males, and the death rate for blacks is 40 percent higher – to a great degree because of heavier smoking by blacks.

And that is not risk-free "charity" from the companies pushing booze and beer. Dr. Leffall points out that alcohol and tobacco make an especially deadly combination in terms of producing cancer of the mouth, throat and esophagus. The esophageal cancer rate is four times as high among black males as whites, and blacks die at a rate 240 percent higher than for whites.

But perceptive blacks are beginning to complain that a lot more than cancer and other medical diseases are involved. They see Billy Dee Williams on television suggesting that a can of Colt .45 will lure a beautiful woman into the sack "every time," and they conclude, reasonably, that this ad for malt liquor promotes sexual looseness, which is another scourge of young blacks.

Companies and advertising agencies say that they direct a lot of beer, booze and tobacco ads at black America because blacks smoke and drink a lot. Blacks are making the point that they also buy a lot of cars, houses, TV sets, radios, clothing, food and medicine, but the ad agencies rarely advertise those wholesome products in black newspapers and magazines or on black radio stations. The emphasis is added that the disproportionate levels of black smoking and alcohol consumption probably result directly from the fact that this is where corporate America chooses to focus its "glamour" ads and its promotional activities.

Leaders of black-owned media say they face a horrible dilemma: If they don't take the ads and promotions from the sellers of cigarettes and alcohol they will have nothing – and go out of business. This is a dreadful "Catch 22."

Companies that sell tobacco, booze and beer need to reexamine their policies, and consciences. So do those who sell automobiles, shoes, pain pills and milk and butter.

4. See ISSUE 5, page 47.

"Enough Food for Everyone," **Population Digest**,

A Masai tribesman in Kenya, when advised to kill a few of his skinny cattle to feed his starving children, replied, "No, I can easily get more children, but I cannot get more cattle." He and his family derive the major portion of their nourishment from a drink he prepared of cow's blood and milk.

In India, about 400 million devout Hindus would rather starve than stop a monkey or sacred cow from eating the food grain. Har Lal, a villager in Sultanpur, said, "Well, they do eat the crops, but after all, the blessing of the Gau Mata (cow goddess) is a great thing."

An African tribesman shrugged his shoulders when his corn crop died on the stalk. "It is in the hands of God," he said. A Moroccan farmer murmured, "Allah-y-jib" (God will provide), when the sun burned his barley crop to a crisp.

Rapidly growing populations create many problems for a country: overcrowded cities, unemployment, a strain on health services. The most serious concern, however, is feeding the people. Food production is affected by many factors such as the availability of soil and water, the weather, pests, storage, and transportation facilities. In some countries religious traditions and lack of knowledge further complicate the problem of providing food for everyone.

Starvation kills 10,000 each week

It is estimated that one out of eight of the world's people is malnourished. In Africa, Asia and Latin America (the Third World), more than 10,000 people die of starvation each week. At least one out of every four children born in the developing countries will not reach the age of five. They will die because they are undernourished. Their bodies are weak and easily destroyed by germs and diseases. Some children, who might otherwise die, survive because they receive minimal medical care.

...many others are deformed

If a malnourished child escapes death, lack of proteins, vitamins, and minerals causes further problems. Without adequate nourishment, a child may be mentally retarded or physically deformed. A hungry child has a pathetic look. The face may age, but the body remains child-sized.

One deforming hunger disease is called "kwashiorkor." Its victims have piercing eyes, bloated bellies, arms and legs that look like matchsticks. Rib cages stand out like fence posts on sunken chests and skin sags on emaciated bodies like an elephant's hide.

Enough food for a family

In India, Har Lal is satisfied if his crops survive the fall monsoons and he reaps enough barley to feed his family. He has neither the tools nor the money to produce extra food, a common problem throughout most of Africa and Asia. There is no surplus to share, sell, or store for an unproductive year.

...enough food for 56 other people

According to the Department of Agriculture, the American farmer in 1976 produced enough food to feed himself and 56 others. Some of this food was given or sold to developing countries. Foreign aid is a temporary solution to the food problem. More permanent solutions are needed. An ancient Chinese proverb says:, "Give a man a fish, and he will eat for a day. Teach him how to fish, and he will eat the rest of his life.'

Helping

The United States and other agricultural nations, private foundations, and churches send thousands of experts to the developing world to teach people how to grow more food. They have sent scientists and farm specialists into the fields and rice paddies. The experts do not always introduce machines and other technology because it is difficult for farmers to change their farming methods so drastically. The experts demonstrate how to plant better seeds, how to use certain pesticides and how to raise more productive crops. Their contribution is valuable, but has had only a small impact on the problem. While food production has increased, population has grown at an even faster rate.

200,000 more people each day

The world's population grows each day by about 200,000 persons, or about 75 million per year. By the end of this century, if current trends continue, the population will increase from the present four billion* to over six billion. Millions of tons of additional food will have to be produced to feed these new stomachs.

Can the world feed 6 billion?

Will it be possible to feed the projected six billion people? An authority in food science, Dr. George A. Borgstrom, wrote that if all of the world's food were evenly distributed, and if each person were given an equal share, everyone would be malnourished. He claimed that the world is already short of food, and population is outstripping whatever gains have been made in agriculture and fisheries.

Professor Everett S. Bee says, "There is no escaping the conclusion that at present rates of growth the world pop-

* Five billion as of July, 1987.

ulation will soon exceed our capacity to provide food and other necessary natural resources.'

Biologist Barry Commoner disagrees. "...the amount of food crop produced in the world at present is sufficient to provide an adequate diet to about eight billion people – twice the world population."

Economist William R. Gasser also is optimistic. "The world has the physical capacity to feed itself, no doubt about it. Less than half the arable land on this planet is being cultivated now. And the technology, fertilizer, and other raw materials will be available if people and their governments are willing to pay the price."

Food – fertility link?

Recent studies have found a link between available food and family size. When food is scarce, families tend to have more children in order to replace those they expect to die of starvation. When food is plentiful, family size declines, because parents know that the children they have will probably live to adulthood.

In Indonesia, the fertility rate dropped 29 percent between 1968 and 1975.

According to Richard Critchfield, an analyst of Third World rural development, "American technology, in the form of contraceptives and modern agriculture" played a key role in the turn-about. Indonesia once had a policy of "the more the better" and banned birth control. But in 1970 the government began an intensive family planning program. At the same time the use of high-yield, fertilizer-intensive rice was introduced. Food supplies increased and, with the help of contraceptives, family size went down.

Opinion about the world's capacity to feed a growing population is strongly divided. One fact is not disputed: hunger and malnutrition are of staggering proportions, and must be the concern of all nations. As Dr. Addeke Boerma points out, "...the availability of sufficient food for all the people of this world is a vital component of world economic security. And, as such, it is increasingly a condition of world peace."

5. See ISSUE 5, page 48.

Calorie Tables

Food and Measures*	Approximate Calories
A	
Almonds – 12-15	100
Apple butter – 1 tbs	40
Apples	
Baked – 1 lg. and 2 tbs sugar	200
Fresh – 1 large	100
Applesauce, sweetened – 1/2 cup	100
Apricots	
Canned in syrup - 3 lg. halves	100
Dried – 10 sm. halves	100
Asparagus	
Fresh or canned 5 stalks 5 ins. long	15
Avocado – 1/2 pear 4 ins. long	265
B	
Bacon – 2-3 long slices, cooked	100
Bacon fat – 1 tbs.	100
Banana – 1 med., 6 ins. long	90
Beans	
Canned with pork – 1/2 cup	175
Dried – 1/2 cup, cooked	135
Lima, fresh or canned – 1/2 cup	100
Snap, fresh or canned – 1/2 cup	25
Beef (cooked)	
Corned – 1 slice, 4 by 1 1/2 by 1 ins.	100
Dried – 2 ozs.	100
Hamburger – 1 patty (3 ozs.)	300
Round, lean – 1 med. slice (2 ozs.)	250
Sirloin, lean – 1 av. slice (3 ozs.)	250
Tongue – 2 ozs.	125
Beet greens – 1/2 cup, cooked	30
Beets, fresh or canned – 2 beets, 2 ins. in diam.	50
Biscuit, baking powder – 2 ins. in diam.	100
Blackberries, fresh – 1 cup	100
Blueberries, fresh – 1 cup	90
Bologna – 1 slice, 2 ins. by 1/2 ins. thick	100
Breads	
Boston brown – 1 slice 3 ins. in diam. 3/4 in. thick	90
Corn (1 egg) – 1, 2-in. square	120
Cracked wheat – 1 slice, av.	80
Dark rye – 1 slice, 1/2 in. thick	70

* 1 cup equals 8 ounces, 3 teaspoons (tsp.) equal 1 tablespoon (tbs.). 4 tablespoons (tbs.) equal 1/4 cup.

Food and Measures*	Approximate Calories
Light rye – 1 slice, 1/2 in. thick	75
White, enriched – 1 slice, av.	75
White, enriched – 1 slice, thin	55
Whole wheat, 60% – 1 slice, av.	70
Whole wheat, 100% – 1 slice, av.	75
Broccoli – 3 stalks, 5 1/2 ins. long	100
Brownies – 1 piece, 2 by 2 by 3/4 ins.	140
Brussels sprouts – 6 sprouts, 1 1/2 ins. in diam.	50
Butter – 1 tbs	95
C	
Cabbage, cooked – 1/2 cup	40
raw – 1 cup	25
Cake	
Angel – 1/10 of a lg. cake	155
Chocolate or vanilla no icing – 1 piece 2 by 2 by 2 ins.	200
Chocolate or vanilla with icing – 1 piece 2 by 1 1/2 by 2 ins.	200
Cupcake with chocolate icing – 1 medium	250
Cantaloupe – 1/2 of a 5 1/2-in. melon	50
Carrots – 1 carrot 4 ins. long	25
Cashew nuts – 4-5	100
Cauliflower – 1/4 of a hd., 4 1/2 ins. in diam.	25
Caviar – 1 tbs.	25
Celery – 2 stalks	15
Cheese	
American cheddar – 1 cube, 1 1/8 ins. square or 3 tbs. grated	110
Cottage – 5 tbs.	100
Cream – 2 tbs.	100
Cherries, sweet – 15 lg.	75
Chicken	
Broiled – 1/2 med. broiler	270
Roast – 1 slice, 4 by 2 1/2 by 1/4 ins.	100
Chinese cabbage – 1 cup raw	20
Chocolate	
Milk, sweetened – 1 oz.	140
Fudge – 1 piece 1 in. sq. by 3/4 in. thick	100
Malted milk – fountain size	460
Mints – 1 mint, 1 1/2 ins. in diam.	100
Milk with almonds, sweetened – 1 oz.	150
Syrup – 1/4 cup	200
Unsweetened – 1 square	
Cider, sweet – 1 cup	100
Clams – 6 round	100
Cocoa, half milk, half water – 1 cup	150
Coconut – 1/2 cup, fresh	175
Cod-liver oil – 1 tbs.	100
Cod steak – 1 piece, 3 1/2 by 2 by 1 in.	100
Cola soft drinks – 6 oz. bottle	75
Collards – 1/2 cup, cooked	50
Cooking fats, vegetable – 1 tbs.	100
Corn – 1/2 cup	70
Corn syrup – 1 tbs.	75
Corn flakes – 1 cup	80
Corn meal – 1 tbs., uncooked	35
Cornstarch pudding – 1/2 cup	200
Crackers	
Graham – 1 square	35
Peanut butter-cheese sandwich – 1 cracker	45
Round snack-type – 1 cracker, 2 ins. in diam.	15
Rye wafers – 1 wafer	25
Saltines – 1 cracker, 2 ins. sq.	15
Cranberry sauce – 1/4 cup	100
Cream	
Light – 2 tbs.	65
Heavy – 2 tbs.	120
Whipped – 3 tbs.	100
Cream-puff shells – 1 shell	85
Cucumber – 1/2 medium	10
Custard, boiled or baked – 1/ cup	130
D	
Dates – 4	100
E	
Egg – 1 medium size	75
Eggplant – 3 slices, 4 ins. in diam. 1/2 in. thick, raw	50
Endive – av. serving	10
Escarole – av. serving	10

Food and Measures*	Approximate Calories
F	
Figs, dried – 3 small	100
Flour, white or whole grain – 1 tbs., unsifted	35
Frankfurter – 1 sausage	125
G	
Gelatin, fruit flavored, dry – 3 oz. pkg.	330
Ready to serve – 1/2 cup	85
Ginger ale – 1 cup	85
Gingerbread, hot water – 2 by 2 by 2 ins.	200
Grapefruit juice Unsweetened – 1 cup	100
Grape juice – 1/2 cup	80
Grape nuts – 1/4 cup	100
Grapes American or Tokay 1 bunch-22, av.	75
Seedless – 1 bunch-30 av.	75
Griddle cakes – 1 cake, 4 ins. in diam.	75
H	
Halibut – 1 piece, 3 by 1 3/8 by 1 ins.	100
Ham, lean – 1 slice, 4 1/4 by 4 by 1/2 ins.	265
Hard sauce – 1 tbs.	100
Hickory nuts – 12-15	100
Hominy grits – 3/4 cups, cooked	100
Honey – 1 tbs.	100
I	
Ice cream – 1/2 cup	200
Ice cream soda – fountain size	325
J	
Jellies and jams – 1 rounded tbs.	100
K	
Kale – 1/2 cup, cooked	50
L	
Lamb, roast – 1 slice, 3 1/2 by 4 1/2 by 1/8 ins.	100
Lard – 1 tbs.	100
Lemon juice – 1 tbs.	5
Lettuce – 2 lg leaves	5
Liver – 1 slice, 3 by 3 by 1/2 ins.	100
Liverwurst – 2 ozs.	130
Lobster meat – 1 cup	150
M	
Macaroni – 3/4 cup, cooked	100
Maple syrup – 1 tbs.	70
Margarine – 1 tbs.	100
Marshmallows – 1	20
Milk Buttermilk – 1 cup	85
Condensed – 1 1/2 tbs.	100
Evaporated – 1/2 cup (1 cup diluted)	160
Skim milk, dried – 2 1/2 tbs.	100
Skim milk, fresh – 1 cup	85
Whole milk – 1 cup	170
Yogurt, plain – 1 cup	120-160
Mints, cream – 1/2 in. cube	5
Molasses – 1 tbs.	70
Muffins Bran – 1 medium	90
1-egg – 1 medium	130
Mushrooms – 10 large	10
Mustard greens – 1/2 cup, cooked	30
N	
Noodles – 3/4 cup, cooked	75
O	
Oatmeal – 3/4 cup, cooked	110
Oil – corn, cottonseed, olive, and peanut – 1 tbs.	100
Okra – 10-15 pods	50
Olives Green – 6 medium	50
Ripe – 4-5 medium	50
Onions – 3-4 medium	100
Orange – 1 medium	80

Food and Measures*	Approximate Calories
Juice – 1 cup	125
Oysters – 5 medium	100
P	
Parsnips – 1 parsnip, 7 ins. long	100
Peaches	
Canned in syrup – 2 lg. halves and 3 tbs. juice	100
Dried – 4 medium halves	100
Fresh – 1 medium	50
Peanut butter – 1 tbs.	100
Peanuts, shelled – 10	50
Pears	
Canned in syrup – 3 halves and 3 tbs. juice	100
Fresh – 1 medium	50
Peas	
Canned – 1/2 cup	65
Fresh – shelled – 3/4 cup	100
Pecans – 6	100
Pepper, green – 1 medium	20
Pickles, cucumber	
Sour and dill – 10 slices 2 ins. in diam.	10
Sweet – 1 small	10
Pies – (sectors from 9 in. pies)	
Apple – 3 in. sector	200
Lemon meringue – 3 in. sector	300
Mincemeat – 3 in. sector	300
Pumpkin – 3 in. sector	250
Pineapple	
Canned, unsweetened – 1 slice, 1/2 in. thick and 1 tbs. juice	50
Fresh – 1 slice, 3/4 in. thick	50
Juice, unsweetened – 1 cup	135
Plums	
Canned – 2 med. and 1 tbs. juice	75
Fresh – 2 medium	50
Popcorn, plain – 1 1/2 cups, popped	100
Popovers – 1 popover	100
Pork chip, lean – 1 med.	200
Potato chips – 8-10 lg.	100
Potato salad with mayonnaise – 1/2 cup	200
Potatoes	
Mashed – 1/2 cup	100
Sweet – 1/2 medium	100
White – 1 medium	100
Prune juice – 1/2 cup	100
Prunes, dried – 4 medium	100
Pumpkin – 1/2 cup	50

Food and Measures*	Approximate Calories
R	
Radishes – 5	10
Raisins – 1/4 cup	90
Raspberries, fresh – 1 cup	90
Rhubarb, stewed and sweetened – 1/2 cup	100
Rice – 3/4 cup, cooked	100
Roll, Parker House – 1 medium	100
Rutabagas – 1/2 cup	30
S	
Salad dressing	
Boiled – 1 tbs.	25
French – 1 tbs.	90
Mayonnaise – 1 tbs.	100
Salmon, canned – 1/2 cup	100
Sardines, drained – 5 fish, 3 ins. long	100
Sauerkraut – 1/2 cup	15
Sherbet – 1/2 cup	120
Soup, condensed – 11 oz. can	
Mushroom	360
Noodle	290
Tomato	230
Vegetable	200
Spaghetti – 3/4 cup, cooked	100
Spinach – 1/2 cup, cooked	20
Squash	
Summer – 1/2 cup, cooked	20
Winter – 1/2 cup, cooked	50
Strawberries, fresh – 1 cup	90
Sugar	
Brown – 1 tbs.	50
Granulated – 1 tbs.	50
Powdered – 1 tbs.	40
Sweetbreads, calves' – 1 pair med. sized	200
Swiss chard – 1/2 cup leaves and stems	30
T	
Tangerines – 1 medium	60
Tapioca, uncooked – 1 tbs.	50
Tomato juice – 1 cup	60

70

Food and Measures*	Approximate Calories
Tomatoes, canned – 1/2 cup	25
Fresh – 1 medium	30
Tuna fish, canned – 1/4 cup, drained	100
Turkey, lean – 1 slice, 4 by 2 1/2 by 1/4 ins.	100
Turnip – 1 turnip, 1 3/4 ins. in diam.	25
Turnip greens – 1/2 cup cooked	30
V	
Veal, roast – 1 slice, 3 by 3 3/4 by 1/2 ins.	120
W	
Waffles – 1 waffle, 6 ins. in diam.	250
Walnuts – 8	100
Watermelon – 1 round slice, 6 ins. in diam. 1 1/2 ins. thick, no rind	190
Wheat Flakes – 3/4 cup	100
Germ – 1 tbs.	25
Shredded – 1 biscuit	100
* * *	
Alcoholic beverages	
Beer – 8 ozs.	120
Gin – 1 1/2 ozs.	120
Rum – 1 1/2 ozs.	150
Whiskey – 1 1/2 ozs.	150
Wines	
Champagne – 4 ozs.	120
Port – 1 oz.	50
Sherry – 1 oz.	40
Table, red or white – 4 ozs.	95

Appendix D – Sample Evaluation Items

The *Unified Science* course should be conducted with ample incidences of formative evaluation designed to assess mastery of process and application skills. This type of evaluation will include a number of different forms of observing and recording student progress, as distinct from the emphasis on cognitive acquisitions and behaviors necessary in summative evaluation. A very useful reference for information on evaluation is the *Handbook on Formative and Summative Evaluation of Student Learning*, Bloom, B. *et al*, McGraw-Hill, Inc., 1971.

The following are some examples of test items which can serve as models for the construction of tests to be used in the local course of study. Since the emphasis implicit in the syllabus suggests the development of skills and the ability to apply processes and information learned, and to make decisions, the items below progress rather quickly from recall-type to process type. Process-oriented evaluation items are increasingly available and these should predominate in both the formative and summative evaluation used in this course. It is less useful for these students to be able to simply recall a wide variety of facts than it is for them to be able to apply skills to problems and make decisions about issues that will be important in their lives.

1. At the present time where does most of the energy used in this country come from?
   A. nuclear reactors
   B. hot springs
   C. falling water
   D. solar batteries
   E. burning of fuels

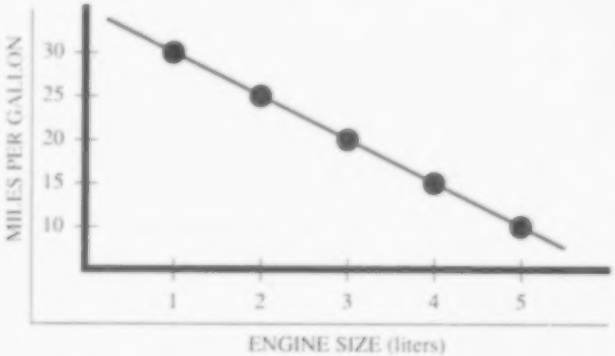
2. If equal amounts of the following foods are eaten, which one would provide the most protein for the body?
   A. potatoes
   B. apples
   C. rice
   D. bread
   E. chicken

3. Where is the energy for photosynthesis generally obtained?
   A. chlorophyll
   B. chloroplasts
   C. sunlight
   D. carbohydrates
   E. carbon dioxide

4. Under which of the following conditions does water evaporate fastest?
   A. on a hot and dry day
   B. on a hot and moist day
   C. on a cold and dry day
   D. on a cold and moist day
   E. on a calm and moist day

5. If you are facing North early in the morning, where is the Sun?
   A. to your left
   B. to your right
   C. behind you
   D. in front of you
   E. above you

6. A consumer group measured the miles per gallon cars get with different size engines. The results are graphed below.



Which of the following is the **best** description of the relationship shown on the graph?

A. the larger the engine, the more miles per gallon the car gets
B. the fewer miles per gallon the car gets, the smaller the engine
C. the smaller the engine, the more miles per gallon a car gets
D. the more miles per gallon for a car, the larger the engine

7. In his school, Dan thinks the boys are taller, on the average, than the girls. Rose thinks the girls are taller. What would be the **surest** way to find out who is right?
A. ask a teacher who knows all the students in school
B. look up the average height of people of various ages in an encyclopedia
C. measure the height of all the boys and girls in the school
D. look at the school records which tell how tall the students were when they entered
E. see who is taller, Dan or Rose

8. One morning a glass containing salt water is placed in a large bottle. The bottle is tightly sealed and placed in the sunlight.

During the day drops of water form inside of the large bottle and collect at the bottom. No water spills out of the glass.

How salty does the water at the bottom of the large bottle taste?
A. as salty as the water in the glass
B. a little less salty than the water in the glass
C. a lot less salty than the water in the glass
D. only a very slight taste of salt
E. no taste of salt

Appendix E – Reading and Writing in Science

1. Reading in Science

Improving reading and study skills in science classes*

Nature of the science text materials. Science textbooks generally contain a great deal of extremely concise material. Statements of laws, definitions, characteristics of various situations, and formulas must be read and understood. Descriptive passages and directions for experiments, life cycles of plants, and processes involving inanimate forms are presented. Students must frequently make generalizations and inferences on the basis of this information.

Improving comprehension. The textbook, then, makes many demands upon the reader. Memorization of these facts does not necessarily mean understanding the facts. While the student reads his textbook he must constantly question himself: What is the fact? Why is it so? Are there limits to its application? What are the limits? He compares materials and searches for likenesses and differences that exist in the general framework of new material.

In science classes, the teacher should familiarize pupils with the types of passages characteristic of science textbooks and from time to time give specific assistance in reading each of these types:

- Passages presenting factual details leading to a general conclusion or concept
  The reader is required to note the facts, remember them while completing the passage, visualize the relationships, and grasp the conclusion.
- Passages presenting details of processes
  These involve following time order, among other relationships. The reader must attend to the proper sequence of steps in the process. Diagrams and formulas often accompany the explanations and must be carefully examined as the text is read.
- Passages involving classification
  The reader is asked to note similarities and differences, often minute. Pictures are frequently supplied in the text, and the reader should observe these closely to note details.
- Passages giving directions for pupil performance
  Directions must be read first from beginning to end, reread to comprehend and visualize each step, and read again as each step is carried out. A final reading is necessary to check the accuracy of the pupil's actual operation and to verify the results.
- Passages presenting problems for solution
  The reader must determine what is to be found, what facts are known, what other facts are needed, what steps are to be followed in solving the problem, and how the result is to be verified. (Variation: Some passages present a problem, followed by an explanation of how the problem was solved by scientists.)
- Graphs, charts, tables, diagrams, and pictures
  The reader must be attentive to all parts of such graphic presentation, including captions, titles, labels, and keys.

Especially in the first weeks of the school year, science teachers can profitably provide specific practice for efficient reading of each of the types listed above. They may use the five-phase technique described earlier in this chapter or some of the other techniques suggested in this and in the chapter "Reinforcing and Extending the Common Skills" - such as written or oral comprehension checks followed by discussion that helps the student understand **why** his answer is correct or incorrect.

All readers, from the most capable to the least capable, relate the content of their reading to past personal experience, through reading or other study activities. Therefore, prior experience of a science topic serves to increase comprehension of a textbook treatment of the topic. Furthermore, on occasions when the teacher wishes to preserve a sense of discovery or at times give the pupils opportunity for inductive reasoning, the reading assignment will be done following experiences such as

* Excerpted from, **Reading in Secondary Schools**, Bureau of Curriculum Development, The State Education Department, Albany, NY. 1969. pages 36-40.

demonstrations, field trips, discussions, and the viewing of films or other audio-visual materials. (Laboratory experiences usually require some reading before the pupils start their laboratory work.)

All pupils, especially the less able readers, will better understand the text matter if they have been prepared through development of their experiential backgrounds relevant to the matter being studied.

Developing vocabulary. The vocabulary to be learned is to be considered under two categories – the technical vocabulary and the nontechnical. Technical vocabulary is part and parcel of the subject matter, represented by such terms as *osmosis, photosynthesis, neutron, sedimentary*. Nontechnical vocabulary consists of words used in various other subject areas and in general reading, as well as in science, such as *pressure, maintain, structure, circulate, permeate*.

The problem of vocabulary load for the pupil is pointed up by Mallinson, who found that science textbooks in general introduced 125 new technical terms in grades 7 and 8, 175 in grades 9 and 10, and 250 in grades 11 and 12.* The nontechnical vocabulary is more difficult in some textbooks than in others. Teachers should be alert for possible difficulties with certain nontechnical words.

The instructor might select a technique, such as one of the following, for dealing with problems of vocabulary and concepts in the science class.

- When introducing a new unit of work, he could construct a pretest of terms to be used in the unit. Later, when the terms are encountered in the text, he will pay particular attention to the clarification of the terms that pupils missed on the pretest.
- He may choose to present new or unfamiliar terms on the chalkboard or on a chart for discussion before the text is read. The pupils should locate these words in the text so that they can utilize contextual clues (as well as diagrams, the glossary, or the dictionary) to arrive at the meaning of the term.
- He may present a film, video or filmstrip depicting a concept that is difficult to verbalize. Pupils view the film with a definite purpose, directed by questions that are presented in advance. During the subsequent discussion, the pupil is led to a thorough understanding of the concept that was presented and the terms used in verbalizing it.
- He may require students to keep notebooks, give oral reports, do experiments, or to prepare oral quizzes. Such activities provide for repetition of terms and help assure some degree of retention of new vocabulary. Written work provides the student with the opportunity to attend to the spelling of a term; oral work, to the pronunciation of the term.

There is a certain category of words or written symbols that should receive special attention – those words or symbols which have meanings in mathematics or in other subjects which are different from the meanings attached to them in science.

For instance, such words as *inversion, base, solution,* and *radical*, such symbols as the plus sign (*positive number* or *symbol for addition* in mathematics and *reacts with* in chemistry), or the degree sign (applied to measurement of an angle or to temperature) merit this attention.

Words of general use that have specificity in science can also cause confusion when initially encountered; e.g., *culture, force, property, power, retort,* and *gravity*.

Much technical vocabulary in science is learned as a direct result of laboratory experiences, field trips, teacher demonstrations, or audio-visual presentations. That is, a pupil will learn a word such as *inertia* through demonstrations or laboratory experiences.

The study of words should include spelling and pronunciation.

Study of roots and affixes. Because many words in science derive from combinations of Greek and Latin elements, there is value in attention to roots, prefixes, suffixes, and combining forms which are common to many science words. The following suffixes used in other areas are widely used in science:

-aceous	pertaining to, resembling (*herbaceous, crustaceous*)
-cide	denoting killing (*insecticide*)
-logy	science of (*zoology*)
-meter	unit of measure (*centimeter*); instrument for measurement (*thermometer*)
-scope	denoting viewing (*microscope*) or observing (*gyroscope, stethoscope*)

The following endings deserve special attention because of their specific uses in science:

-ase	denoting a ferment; used in forming the names of enzymes (*amylase*)
-ate	denoting a salt or ester formed from those acids whose names end in *-ic* (*nitrate*), except a few acids whose names begin with *hydro-* (*hydrocyanide*)
-emia	denoting a condition of the blood (*anemia*)

* G. G. Mallinson. *Methods and Materials for Teaching Reading in Science*. Chicago University. Conference on Reading. Proceedings. 1959. No. 21. Chicago Univ. of Chicago Press, 1959.

-gen	denoting a substance that produces or a thing produced (*oxygen*)
-ide	denoting the name of a compound (*oxide*)
-in(ine)	denoting a substance of definite composition not known or manufactured before the advent of modern science (*vitamin*). Note: Chemical elements ending in *-in* or *-ine* usually are nonmetals (*chlorine*), as distinct from elements ending in *-um* or *-ium* (*aluminum*).
-itis	inflammation of (*laryngitis*)
-oid	resembling or like (*spheroid*)
-ose	denoting a carbohydrate (*cellulose*) or alteration of a protein (*proteose*)
-um(ium)	denoting an elementary metal (*aluminum, sodium*)

Note: Metals known in ancient times are exceptions as to their common names. They also have Latin names used in abbreviated form in chemical formulae – gold (***au**rum*), iron (***ferr**um*), silver (***arg**entum*), tin (***st**annum*), copper (***cu**prum*), lead (***plumb**um*), etc.

The following are some of the beginning forms or prefixes especially used in science:

di-	two, twice; in chemistry denoting two atoms, radicals, groups, or equivalents (*diacetate*)
hemo-	blood (*hemoglobin*)
macro-	large (*macrophage, macroscopic*)
micro-	small, minute (*microorganism*); in various terms in electricity and mechanics it denotes one millionth of a part of a specified unit (*microampere*)
mono-	one, single (*monosaccharides*)
neur-	pertaining to nerves (*neurology*)
thermo-	heat (*thermonuclear, thermometer*)

The skills list that follows sets forth skills that are particularly important to full comprehension of scientific materials.

READING SKILLS CHECKLIST FOR SCIENCE

The student learns to:

Comprehend factual materials

Recognize the main idea _____
- note details _____
- select relevant facts _____
- define problem _____

Organize and classify facts

Note sequence _____

Read critically _____
- draw inferences _____
- draw conclusions _____
- separate fact from opinion _____

Recognize relationships _____
- cause and effect _____
- sequence _____

Adjust reading rate to purpose _____

Increase his vocabulary

Recognize and understand technical terms _____
- note exact meanings _____
- suit meaning to context _____

Use dictionary and glossary as an aid to understand _____

Understand pictorial materials

Graphs _____

Diagrams _____

Cartoons and other representations of specific facts _____

Follow directions _____

Retain and recall

2. Writing in Science

Refer to the State Education Department publication, *Reflections on Writing in Science*, 1984.

Appendix F — Goals of the Board of Regents for Elementary and Secondary Education in New York State

1. Each student will master communication and computation skills as a foundation to:
   - 1.1 Think logically and creatively.
   - 1.2 Apply reasoning skills to issues and problems.
   - 1.3 Comprehend written, spoken and visual presentations in various media.
   - 1.4 Speak, listen to, read and write clearly and effectively in English.
   - 1.5 Perform basic mathematical calculations.
   - 1.6 Speak, listen to, read and write at least one language other than English.
   - 1.7 Use current and developing technologies for academic and occupational pursuits.
   - 1.8 Determine what information is needed for particular purposes and be able to acquire, organize and use that information for those purposes.
2. Each student will learn methods of inquiry and knowledge gained through the following disciplines and use the methods and knowledge in interdisciplinary applications:
   - 2.1 English language and literature.
   - 2.2 History and social sciences.
   - 2.3 Mathematics.
   - **2.4 Natural Sciences and Technology.**
   - 2.5 Language and literature in at least one language other than English.
3. Each student will acquire knowledge, understanding and appreciation of the artistic, cultural, and intellectual accomplishments of civilization and develop the skills to express personal artistic talents. Areas include:
   - 3.1 Ways to develop knowledge and appreciation of the arts.
   - 3.2 Aesthetic judgments and the ability to apply them to words of art.
   - 3.3 Ability to use cultural resources of museums, libraries, theater, historic sites and performing arts groups.
   - 3.4 Ability to produce or perform works in at least one major art form.
   - 3.5 Materials, media and history of major art forms.
   - 3.6 Understanding of the diversity of cultural heritages.
4. Each student will acquire knowledge about political, economic, and social institutions and procedures in this country and other countries. Included are:
   - 4.1 Knowledge of American political, economic, and social processes and policies at national, state, and local levels.
   - 4.2 Knowledge of political, economic, and social institutions and procedures in various nations; ability to compare the operation of such institutions; and understanding of the international interdependence of political, economic, social, cultural, and economic systems.
5. Each student will respect and practice basic civic values and acquire the skills, knowledge, understanding, and attitudes necessary to participate in democratic selfgovernment. Included are:
   - 5.1 Understanding and acceptance of the values of justice, honesty, self discipline, due process, equality, and majority rule with respect for minority rights.
   - 5.2 Respect for self, others, and property as integral to a self-governing, democratic society.
   - 5.3 Ability to apply reasoning skills and the process of democratic government to resolve societal problems and disputes.
6. Each student will develop the ability to understand, respect and accept people of different race; sex; cultural heritage; national origin; religion; and political, economic, and social background, and their values, beliefs, and attitudes.
7. Each student will acquire knowledge of the ecological consequences of choices in the use of the environment and natural resources.
8. Each student will develop general career skills, attitudes and work habits, and make a self-assessment of career prospects. Students not directly pursuing postsecondary education will acquire entry-level employment skills.
9. Each student will learn knowledge, skills, and attitudes which enable development of:
   - 9.1 Self-esteem.

9.2 The ability to maintain physical, mental, and emotional health.

9.3 Understanding of the ill effects of alcohol, tobacco, and other drugs.

10. Each student will develop a commitment to lifetime learning with the capacity for undertaking new studies, synthesizing new knowledge and experience with the known, and refining the ability to judge.

*Appendix G – Excerpts from a National Science Teachers Association Position Statement**

The goal of science education during the 1980's is to develop scientifically literate individuals who understand how science, technology, and society influence one another and who are able to use this knowledge in their everyday decision making. The scientifically literate person has a substantial knowledge base of facts, concepts, conceptual networks, and process skills which enable the individual to continue to learn and think logically. This individual both appreciates the value of science and technology in society and understands their limitations.

The attributes listed below help to describe a scientifically literate person. Each attribute should be thought of as describing a continuum along which the individual may progress. The progress of the individual's science education should be equated with progress along this continuum.

The scientifically and technologically literate person:

- used science concepts, process skills, and values in making responsible everyday decisions;
- understands how society influences science and technology as well as how science and technology influence society;
- understands that society controls science and technology through the allocation of resources;
- recognizes the limitations as well as the usefulness of science and technology in advancing human welfare;
- knows the major concepts, hypotheses, and theories of science and is able to use them;
- appreciates science and technology for the intellectual stimulus they provide;
- understands that the generation of scientific knowledge depends upon the inquiry process and upon conceptual theories;
- distinguishes between scientific evidence and personal opinion;
- recognizes the origin of science and understands that scientific knowledge is tentative and subject to change as evidence accumulates;
- understands the applications of technology and the decisions entailed in the use of technology;
- has sufficient knowledge and experience to appreciate the worthiness of research and technological development;
- has a richer and more exciting view of the world as the result of science education; and
- knows reliable sources of scientific and technological information and uses these sources in the process of decision making.

Recommendations for High School

The entire NSTA Position Statement was adopted unanimously by the Board of Directors in 1982. Additional copies of the entire position statement are available; write to the National Science Teachers Association, 1742 Connecticut Avenue NW, Washington, DC 20009.

High School Science

The high school science curriculum should enable students to further develop their scientific and technological literacy. Courses incorporating well-designed laboratory and field work help to meet this need.

A balanced core of two years of science should be required of all students, consisting of one year of life science and one year of physical science – both taught in a science-technology-society context. The courses should provide students with opportunities to develop skills in identifying science-based societal problems and in making decisions about their resolution.

Students interested in exploring or preparing for careers in science, engineering, or technical fields should have the opportunity to take additional discipline-based courses in advanced biology, chemistry, physics, and earth sciences. These courses should be planned and sequenced to take advantage of the students' increasing command of mathematics.

Time of science learning

Senior high school level (grades 10-12): a minimum of 1 hour per day for 2 full years of science should be required.

*"Science-Technology-Society: Science Education for the 1980's"

The courses should represent a balance of physical and life sciences.

Emphasis on programs for all students

In elementary, middle, junior high, and senior high school grades, science education programs should provide basic concepts for all students. Opportunities should be available for students with diverse interests and commitments, including students with exceptional interests and talents in science.

Emphasis of laboratory and field activities

High school level laboratory and field activities should emphasize not only the acquisition of knowledge, but also problem-solving and decisionmaking.

Science instruction matches students' cognitive, physical, social, and emotional development

Schools should provide objectives, content, and instructional strategies that are appropriate to the student's stage of mental, moral, and physical development.

Varying strategies and materials should be provided at all grades to accommodate students with various levels of learning skills and mental development.

Emphasis on science-related societal issues

Senior high school level: a minimum of 20 percent of science instruction should be directed toward science-related societal issues.

Appendix H — Guidelines for the use of Vertebrate Animals (Humane Treatment)

Live animals may be kept in school facilities for a number of educationally beneficial purposes, not only for teaching about animals and basic principles of the life sciences and agriculture, but also for teaching about our responsibilities towards animals. To insure that living animals are treated humanely in schools, classroom activities and projects must be carefully selected.

Staff members of the State Education Department, in cooperation with representatives from professional education organizations, developed the enclosed guidelines to assist local school district personnel. These guidelines should guarantee the proper treatment of animals and provide students with an opportunity for appropriate educational experiences.

Guidelines for the Use of Vertebrate Animals in Elementary and Secondary School Programs of New York State

The study of living things is essential to effective instruction in the life sciences including agriculture. If students are not given the opportunity to study directly living organisms, they will be deprived of basic understandings necessary to comprehend and appreciate life and life processes and to develop competencies needed in agriculture and science-related careers.

The teacher's primary goals for demonstrations and investigations involving animals are to achieve an interest in and an understanding of the life processes, to demonstrate biological principles, and to teach proper care and handling of animals. Such instructional activities, investigations, and projects must be well-planned and adequately supervised, and must be conducted with a respect for life and an appreciation of the health and safety of both the animals and the students. Well-planned investigations or projects should include appropriate preparation and an outline of the stages of the activity. In student designed activities, both the initial plan and subsequent modifications must be approved by the instructor.

In any segment of society, the abuse of any living animals for experimentation or any other purpose is intolerable. Because agriculture and the life sciences deal specifically with living things, educators must be especially cognizant of their responsibility to insure the humane treatment of living organisms. This responsibility to encourage humane treatment of animals should extend beyond the confines of the teacher's classroom.

In harmony with Section 809 of the New York State Education Law, these guidelines should be followed when studying vertebrate animals in all elementary and secondary school programs in New York State.

A. Biological studies should lead to and be consistent with a respect for life and all living things. Proper treatment and care of animals should be an integral part of any lesson that includes living animals.

B. Investigations dealing with animals must be within the comprehension and capabilities of the students involved. It is recognized that within a group of students capabilities may vary; however, it is expected that a competent teacher can determine an appropriate level of investigation for a group or for an individual student.

C. Lower orders of life such as protists and invertebrates can reveal much basic biological information, and when possible, should be used as subjects for invasive studies.

D. Vertebrate animals are appropriate objects of study when students:

   1. observe normal living patterns of wild animals in the free living state or in zoological parks, gardens, or aquaria;
   2. observe normal living patterns of pets, fish, or domestic animals;
   3. observe biological phenomena involved with (a) embryonic development, (b) inducing ovulation in frogs, (c) imprinting studies, (d) positive reinforcement studies, (e) environmental studies, and (f) anatomical and physiological studies;
   4. gain direct, practical experience in developing skills in standard practices used when working with domestic and wild animals.

E. Vertebrate animals used in instruction should be properly cared for.

   1. The procurement and use of wild or domestic animals must comply with existing local, state, or federal regulations. Teachers should assure that live animals entering a classroom are healthy and

free from transmissible disease or other conditions that may endanger the health of humans or other animals. Some wild animals are not appropriate for classroom use because they may be carriers of parasites and disease and/or do not adapt well to the conditions imposed by captivity. The use of wild animals as pets should be strongly discouraged.

2. The care of animals should be supervised by a teacher knowledgeable about proper animal care. An animal may be taken to a student's home only with permission from the parent, and should be provided with conditions similar to those prescribed for classrooms.
3. Animals being studied must have appropriate quarters; sufficient space for the normal behavior and postural requirements of the species; proper ventilation, lighting, and temperature control. Adequate food and clean drinking water shall be available. Quarters should be cleaned on a regular basis and located in an area where undue stress and disturbance are minimized.
4. For reasons of conservation, efforts should be made to protect depleted animal species such as *Rana pipiens* (leopard frog). The same educational objectives can frequently be achieved using alternative species or pursuing alternative methods of study.
5. Adequate plans should be made to separate the sexes to control possible unwanted breeding of the species during the project.
6. Preliminary plans should include provisions for the proper disposition of the animals at the conclusion of the study or instructional unit. Laboratory-bred or non-native species must not be released into the wild. Native animals should be acclimated to their natural habitat before release.
7. The plan for an extracurricular project involving animals should be reviewed by a qualified adult supervisor before the project begins. An extracurricular project should be conducted in a suitable area in the school or at a site approved by that supervisor.
8. Supervised occupational experience programs usually require the use of animals owned by students, parents, employers, or the school. Prior to the use of these animals, instruction on the proper care of the animal must have been provided.

F. Studies using vertebrates should be carried out with a respect for life.

1. Animal studies should be carried out under the supervision of a qualified teacher. A student should not be allowed to take the animal home to carry out an experimental study. Such a study should be done in a suitable area in the school. A student may, however, take an animal home during periods when school is not in session in order to provide suitable care.
2. No live vertebrate animal should have performed on it a lesson or experimental study that employs (a) micro-organisms which cause disease in man or animal, (b) ionizing radiation, (c) known cancer producing agents, (d) chemicals at toxic levels, (e) drugs producing pain or deformity, (f) extremes of temperature, (g) electric or other shock, (h) excessive noise, (i) noxious fumes, (j) exercise to exhaustion, (k) overcrowding, (l) paralysis by muscle relaxants, (m) starvation, or (n) other extreme stimuli.
3. If bird embryos are subjected to invasive or potentially damaging experimental manipulations, the embryos' development must be terminated three days prior to hatching. If normal embryos are to be hatched, satisfactory provisions must be made for the care of the young birds.
4. On rare occasions the performance of a surgical procedure or the need to terminate the life of an animal for educational purposes may be necessary. Such use of vertebrates is not appropriate below the secondary level. Surgical procedures should only be performed under the immediate supervision of a bio-medical scientist using appropriate anesthesia and facilities properly equipped to carry out such procedures. This person must have an appropriate advanced degree such as a Ph.D., M.D., D.V.M, D.D.S, and must be actively engaged in the field under investigation. Agricultural practices such as tail docking, dehorning, and castration, should be taught under the supervision of a D.V.M. or a qualified agriculture teacher. Terminating the life of an animal shall be done in a rapid and painless manner by a person trained and proficient in these techniques. Maximum efforts should be made to study as many biological principles and utilize as many body tissues as possible from a single animal.
5. A project which involves living vertebrates must display a statement signed by both the teacher and the student to certify strict adherence to these guidelines.

Selected References

This document is in part based upon individual items or modifications of guidelines taken from the following:

American Humane Society. *Guiding Principles for the Use of Animals by Secondary School Students and Science Club Members.*

Canadian Council on Animal Care. *Guiding Principles Governing the Use of Animals in the Classroom at the Pre-University Level.*

The Humane Society of the United States. *Guiding Principles for the Use of Animals in Elementary and Secondary Education.*

National Association of Biology Teachers. *Guidelines for the Use of Live Animals at the Pre-University Level.*

National Society for Medical Research. *Guiding Principles in the Use of Animals by Secondary School Students and Science Club Members.*

New York State Education Department. *The Humane Treatment of Animals, A Guide for Elementary Teachers.*

State of Indiana. *Guidelines in the Use of Animals by Elementary and Secondary School Students.*

Appendix I

Students with Handicapping Conditions

The Board of Regents, through revising the Part 100 Regulations of the Commissioner and the Action Plan, has made a strong commitment to integrating the education of students with handicapping conditions into the total school program. According to Section 100.2(s) "Each student with a handicapping condition, as such term is defined in Section 200.1(ii) of this Chapter, shall have access to the full range of programs and services set forth in this Part to the extent that such programs and services are appropriate to such student's special educational needs." Districts must have policies and procedures in place to make sure that students with handicapping conditions have equal opportunities to access diploma credits, courses, and requirements.

The majority of students with disabilities have the intellectual potential to master the curricula content requirements for a high school diploma. Most students who require special education attend regular education classes in conjunction with specialized instruction and/or related services. These students must attain the same academic standards as their nonhandicapped peers in order to meet these requirements. For this reason, it is very important that at all grade levels students with handicapping conditions receive instruction in the same content areas so as to receive the same informational base that will be required for proficiency on statewide testing programs and diploma requirements.

The teacher providing instruction through this syllabus/ curriculum has the opportunity to provide an educational setting which will enable the students to explore their abilities and interests. Instruction could be provided to handicapped students either by teachers certified in this subject area or by special education teachers. Teachers certified in this subject area would be providing instruction to handicapped students who are recommended by the Committee on Special Education (CSE) as being able to benefit from instruction in a regular educational setting and are appropriately placed in this setting. Special education teachers may also provide this instruction to a class of students with handicapping conditions in a special class setting.

Teachers certified in the subject area should become aware of the needs of those students with handicapping conditions participating in their classes. Instructional techniques and materials must be modified to the extent appropriate to provide students with handicapping conditions the opportunity to meet diploma requirements. Information or assistance is available through special education teachers, administrators, the Committee on Special Education or a student's IEP.

Strategies for Modifying Instructional Techniques and Materials

1. Prior to having a guest speaker or taking field trips, it may be helpful to structure the situation. Use of a checklist or a set of questions generated by the class will help students focus on relevant information. Accessibility for students with handicapping conditions should be considered when field trips are arranged.
2. The use of computer software may be appropriate for activities that require significant amounts of writing by students.
3. Students with handicapping conditions may use alternative testing techniques. The needed testing modifications must be identified in the student's Individualized Education Program. Both special and regular education teachers need to work in close cooperation so that the testing modifications can be used consistently throughout the student's program.
4. Identify, define and pre-teach key vocabulary. Many terms in this syllabus are specific and may need continuous reinforcement for some students with handicapping conditions. it would also be helpful to provide a list of these key words to the special education teacher in order to provide additional reinforcement in the special educational setting.
5. Check periodically to determine student understanding of lectures, discussions, demonstrations, etc. and how this is related to the overall topic. Encourage students to express their understanding. It may be necessary to have small group discussions or work with partners to determine this.
6. Provide students and special education teachers with a tape of lectures that contain substantial new

vocabulary content and of guest speakers for further review within their special education classes.

7. Assign a partner for the duration of a unit to a student as an additional resource to facilitate clarification of daily assignments, timelines for assignments and access to daily class notes.
8. When assigning long-term projects/reports, provide a timeline with benchmarks as indicators for completion of major project/report sections. Students who have difficulty with organizational skills and time sequence may need to see completion of sections to maintain the organization of a lengthy project/report.

Special education teachers providing this instruction must also become familiar with the goals and objectives of the curriculum. It is important that these teachers provide their students with the same or equivalent information contained in the curriculum.

Regardless of who provides the instruction, the cooperation between teachers of regular and special education programs is essential. It is important for the students as well as the total school environment.

Alternative Testing Techniques

Another consideration in assisting students with handicapping conditions to meet the requirements of regular education is the use of alternative testing techniques. Alternative testing techniques are modifications of testing procedures or formats which provide students with handicapping conditions equal opportunity to participate in testing situations. Such techniques provide the opportunity to demonstrate mastery of skills and attainment of knowledge without being limited or unfairly restricted by the existence of a handicapping condition.

The Committee on Special Education (CSE) is responsible for identifying and documenting a student's need for alternative testing techniques. This determination is made when a student is initially referred to CSE, is reviewed annually for as long as the student receives special education services, and is reviewed when the student is determined to no longer need special education services. *The modifications are to be used consistently throughout the student's educational program.* Principals ensure that students who have been identified by CSE as educationally handicapped are provided the alternative testing techniques which have been recommended by CSE and approved by the Board of Education.

Alternative testing techniques which have been specified on student IEPs for use by a student must be used consistently in both special and regular education settings. Regular classroom teachers should be aware of possible alternative testing techniques and should be skilled in their implementation.

The coordination and cooperation of the total school program will assist in providing the opportunity for a greater number of handicapped students to meet the requirements needed to pursue a high school diploma. The integrated provision of regular education programs, special education programs, remediation, alternative testing techniques, modified teacher techniques and materials, and access to credit through alternatives will assist in enabling such students to pursue high school diplomas to a greater degree. The teacher who provides instruction through this curriculum has a unique opportunity to assist such students in their individual goals.

Additional information on alternative testing modifications is available in the manual entitled *Alternative Techniques for Students with Handicapping Conditions*, which can be obtained from:

New York State Education Department
Office for Education of Children with
Handicapping Conditions
Room 1071 Education Building Annex
Albany, NY 12234

Infusing Awareness of Persons with Disabilities Through Curriculum

In keeping with the concept of integration, the following subgoal of the Action Plan was established:

In all subject areas, revisions in the syllabi will include materials and activities related to generic subgoals such as problem-solving, reasoning skills, speaking, capacity to search for information, the use of libraries and increasing student awareness of and *information about the disabled.*

The purpose of this subgoal is to ensure that appropriate activities and materials are available to increase student awareness of disabilities and issues in regard to disabilities.

This curriculum, by design, includes information, activities and materials regarding persons with handicapping conditions. Teachers are encouraged to include other examples as may be appropriate to their classrooms or the situation at hand. Teachers are also encouraged to assess the classroom environment to determine how the environment may contribute to student awareness of persons with disabilities.